

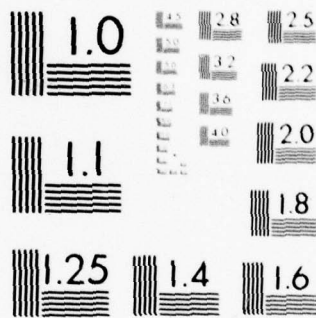
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ACCURACY VALIDATION OF THE MODIFIED NIKE HERCULES RADAR.(U)
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ACCURACY VALIDATION OF THE MODIFIED NIKE HERCULES RADAR

MAY 1979

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US Army Electronics Research and Development Command
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White Sands Missile Range, NM 88002

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) During the week of 7-11 February 1977, 12 balloon flights were made during which the balloon was tracked simultaneously by a modified Nike Hercules radar and a range radar. The range radars used were MPS-36s. The results of these tests and the statistical results of the machine differences are presented. Results show that the Nike Hercules is quite adequate for most mesoscale applications and is also adequate as a standard of comparison for such instruments that might be developed as a replacement for the Army's GMD.		

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INTRODUCTION

For many years the Atmospheric Sciences Laboratory (ASL) has been engaged in programs of testing and evaluating new meteorological instruments or techniques. These programs included the determination of the accuracy of the T-9 radar and the RD-65A and the desirability of using a jimsphere instead of a regular pibal. In testing any new system or instrument, one must have a standard to use for comparison, and the accuracy of this standard must be known before any valid conclusions can be made concerning the object of the test. The ASL has most often relied on the use of an FPS-16 or similar range radar as a standard for comparison. Independent tests¹ made by this laboratory have shown the FPS-16 to be a very accurate instrument, but two limitations--cost and availability--have prompted researchers to investigate the use of other instruments. The least powerful FPS-16 radar is a 1-megawatt radar that requires a two- or three-man operating team, use of range operations, and range scheduling personnel, all of which become very costly. Aside from cost, ASL is not the only agency or project vying for the use of range radars. The ASL must wait its turn if a specific test time or radar is required; otherwise, it must take what time is available. With control of its own inexpensive radar that could be available when a test was desired, ASL could complete projects in a more timely and cost effective manner. For these reasons, the author decided to establish the accuracy of the modified Nike Hercules radar so that it could be used as a standard of comparison in future tests. (NOTE: Column labeled FPS-16 is really MPS-36.)

DISCUSSION

During the week of 7-11 February 1977, 12 balloons were tracked simultaneously by a range radar and the Nike Hercules. Lock-on times vary among the runs because the range radars used were at several different locations. Some of the radars were below the horizon and had to wait until the balloon was high enough to be seen. Balloon tracking time was scheduled for 90 minutes, but premature balloon bursts caused the tracks to have variable termination times.

The range radars used were MPS-36s. These radars have the same stated accuracy as the FPS-16 (± 0.15 milliradian in azimuth and elevation and ± 3 yards range) but have twice the noise because of sequential instead of simultaneous readings of the azimuth and elevation error signals. Since the balloon does not experience any large accelerations, there should be little difference between the MPS-36 and an FPS-16.

¹E. M. D'Arcy, 1975, "Some Behavior Characteristics of the Rawinsonde and AN/FPS-16 Radar when used as Balloon Tracking Devices," ECOM-5555, Atmospheric Sciences Laboratory, US Army Electronics Command, White Sands Missile Range, NM

The data from both the Nike and range radars were processed by the same filtering and smoothing routines so that the two sets of data would be handled the same. The data were then averaged to obtain the 1-minute layer winds centered on the whole minute.

The data are displayed in two formats. The first set of tables (1-12) shows speed and direction versus time. The second set of tables (13-24) shows height and component winds versus time. Tables 25 and 26 show the mean, standard deviation, and variance of the parameters displayed in tables 1-24. Table 27 gives the same values for all runs taken together.

Average speed for the 12 runs varied from a low of 25 knots to a high of 64 knots with an average over the entire set of 34 knots. Of 850 one-minute intervals, the radar winds differed by more than 1 knot only two times. The mean speed difference varied from 0.03 to 0.08 knot with a composite mean of 0.05 knot and standard deviation of 0.24 knot. Azimuth errors were largest at low speeds and were very small at speeds over 10 knots. These errors varied between -0.63 and 0.002 degree with a mean of -0.1 degree and a standard deviation of 1.66 degrees.

The parameter exhibiting the largest amount of variability was height. For single flights, the mean altitude differences vary from -5.4 to +32.0 meters with a mean over the 12 runs of +3.5 meters and a standard deviation of 21.3 meters. Individual differences in the runs varied from -91 to 0 to +47.1 meters, a rather large individual variance. On the other hand, component wind speeds differed from 0 to only 0.07 knot with a mean for the 12 runs of 0 (N-S) and 0.041 (E-W) knots and a standard deviation of 0.27 (N-S) and 0.32 (E-W) knots. Standard deviations of individual runs varied between 0.14 and 0.77 knot.

CONCLUSIONS

Admittedly, 12 samples is not a large number, but one can make some valid conclusions. The individual runs and the composite statistics in table 27 indicate that the errors are random and normally distributed. Considering the range of values, the means for all composite parameters are effectively zero. The causes of the occasional large excursions in the height are not known; however, the excursions do not seem to affect the calculation of wind speed and direction.

Although the Nike Hercules radar is not of the same caliber as an FPS-16, it is quite qualified to be used as a standard of comparison when testing instruments such as the GMD or as a candidate to replace the GMD. The large standard deviation in altitude might prove to be a problem if very fine scale structure is to be investigated. This should not pose any problem when the Nike Hercules radar is used for mesoscale research where averaging times of 1 minute or more and layer thicknesses greater than 200 meters are desired. Possibly, the standard deviation could be reduced by careful peaking of the instrument before each flight; but even at its present stage, the Nike Hercules radar can prove to be a valuable tool.

TABLE 1

LAUNCH 1

7 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
6	9.51	9.46	138.70	138.72
7	11.51	11.87	136.90	136.84
8	10.22	10.27	145.04	145.20
9	6.72	6.64	128.95	128.65
10	1.48	1.62	193.14	189.49
11	1.61	1.87	337.34	332.72
12	4.79	4.73	312.85	312.66
13	5.93	6.07	290.06	290.48
14	7.10	7.00	276.55	275.32
15	10.58	10.82	260.56	261.09
16	15.65	15.51	266.44	265.81
17	16.88	17.16	263.02	263.64
18	18.63	18.50	277.26	277.39
19	18.70	18.84	279.26	279.21
20	15.82	15.90	283.22	283.35
21	16.00	15.97	285.02	285.14
22	15.34	15.40	273.54	273.17
23	14.76	14.90	276.93	277.09
24	12.87	12.82	279.17	279.06
25	14.24	14.28	275.81	276.08
26	12.28	12.09	272.93	272.30
27	10.15	9.91	277.29	276.95
28	9.26	9.22	285.10	285.19
29	9.71	9.37	271.25	271.70
30	9.74	10.01	243.76	244.05
31	11.10	11.08	240.99	239.84
32	12.39	12.40	241.56	241.51
33	12.98	13.05	250.15	250.05
34	16.11	16.19	248.91	249.03
35	17.35	17.56	242.25	242.24
36	16.01	15.91	244.23	244.34
37	17.34	17.38	262.28	262.82
38	17.86	18.26	273.52	273.38
39	30.04	30.37	285.69	285.87
40	37.72	37.57	292.50	292.90
41	43.88	43.92	296.26	296.08
42	48.49	48.32	295.01	295.10
43	45.39	45.28	294.24	294.48
44	45.01	44.95	285.98	285.86
45	52.58	52.86	284.90	284.73
46	52.97	52.89	289.54	289.70

LAUNCH 1 (Cont'd)

7 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
47	57.45	57.56	289.69	289.68
48	60.43	60.53	293.45	293.64
49	58.20	58.14	297.21	297.36
50	55.47	55.81	291.64	291.42
51	62.44	62.39	286.74	286.75
52	71.39	71.65	288.97	288.94
53	70.25	70.03	293.83	293.89
54	64.19	64.31	295.81	295.94
55	59.92	59.86	296.77	296.77
56	49.62	49.57	293.08	292.91
57	52.55	52.63	292.74	292.80
58	54.74	54.86	289.56	289.61
59	57.41	57.73	293.97	294.32
60	58.31	58.28	291.15	291.28
61	61.73	61.85	290.58	290.64
62	66.25	66.05	294.78	294.88
63	66.82	66.94	290.54	290.58
64	70.82	71.05	293.60	293.59
65	67.63	67.30	291.15	291.38
66	59.48	59.50	297.18	296.97
67	61.43	61.49	294.06	294.18
68	62.55	62.85	289.64	289.88
69	66.19	66.01	289.80	289.52
70	66.50	66.57	290.47	290.51
71	62.68	62.71	293.69	294.03
72	62.32	62.45	298.68	298.79
73	59.61	59.41	297.01	296.49
74	52.19	58.07	294.50	294.81
75	50.98	51.27	295.49	295.78
76	57.38	57.62	291.75	291.67
77	56.75	56.34	292.57	291.95
78	53.70	53.77	290.22	291.08
79	47.47	47.43	294.39	294.29
80	45.17	45.21	289.28	289.29
81	47.47	47.57	285.24	285.24
82	47.91	47.88	290.21	290.44
83	41.00	41.03	296.35	295.76
84	35.96	36.36	296.11	297.46
85	34.34	34.16	286.76	287.17
86	35.59	36.06	283.43	281.22
87	43.34	43.52	286.20	285.89

TABLE 2
LAUNCH 2
7 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
3	9.66	9.93	128.98	128.78
4	11.13	10.97	126.88	127.03
5	7.40	7.31	118.45	119.02
6	2.85	2.43	174.75	170.34
7	5.76	6.55	107.37	107.33
8	3.31	3.26	78.56	78.22
9	3.52	3.59	345.43	343.50
10		Missing Data		
11				
12	15.75	15.70	264.60	264.40
13	19.11	19.23	270.49	271.13
14	17.75	17.93	286.00	286.34
15	16.09	15.87	275.79	275.42
16	13.46	13.28	267.81	268.41
17	8.83	8.88	267.04	266.73
18	8.44	8.67	262.48	262.65
19	13.12	13.05	275.31	275.68
20	13.60	13.53	284.94	284.95
21	8.86	8.84	282.72	282.29
22	6.37	6.42	265.56	266.40
23	10.27	10.37	268.65	268.01
24	9.29	9.27	241.84	241.77
25	9.73	9.77	229.21	230.07
26	12.20	12.33	259.87	259.61
27	30.71	30.81	285.82	286.08
28	41.61	42.57	296.33	296.15
29	41.45	41.45	293.94	293.83
30	44.43	44.48	287.61	287.68
31	53.49	53.66	288.53	288.54
32	57.03	57.14	295.38	295.66
33	61.24	61.49	292.32	292.24
34	70.44	70.59	286.47	286.55
35	72.22	72.08	289.22	289.35
36	67.65	67.68	299.25	299.50
37	59.76	59.72	293.79	293.72
38	60.80	60.90	288.43	288.59
39	58.04	58.13	289.72	289.67
40	67.34	67.61	293.89	293.92
41	68.82	68.65	297.11	297.15

LAUNCH 2 (Cont'd)

7 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
42	64.20	64.30	297.61	297.65
43	66.21	66.32	290.01	290.07
44	71.99	72.22	288.70	288.77
45	69.85	69.66	293.88	293.91
46	61.56	61.81	293.15	293.36
47	62.75	62.89	291.67	291.68
48	63.77	63.79	290.97	290.88
49	66.95	66.91	291.67	291.65
50	65.37	65.19	291.02	290.98
51	61.88	62.05	292.31	292.47
52	50.25	49.96	299.57	299.97
53	43.46	43.33	299.39	299.33
54	36.68	36.87	292.81	292.75
55	41.87	41.82	282.79	283.27
56	36.24	35.96	301.30	301.41
57	20.58	20.37	304.78	304.59
58	20.55	20.97	284.15	284.11
59	20.20	19.95	286.17	285.57
60	25.17	25.38	259.83	260.41
61	28.69	28.84	276.61	276.71
62	21.69	21.53	282.86	282.95
63	22.87	22.76	290.60	292.87
64	22.39	22.36	315.67	315.47
65	14.51	14.15	316.18	315.69
66	12.17	11.64	352.32	351.00
67	6.70	6.83	286.83	290.22
68	7.57	7.76	257.78	255.75
69	8.90	9.24	274.52	273.70
70	10.44	10.41	270.49	268.90
71	13.12	12.94	265.13	265.07
72	13.64	13.46	255.14	258.35
73	22.27	22.89	248.61	247.85
74	24.42	24.21	261.66	262.64
75	32.82	33.17	256.47	255.60
76	35.07	35.27	263.18	263.82
77	36.98	36.99	278.44	278.62
78	36.35	36.15	284.01	284.24

TABLE 3

LAUNCH 1

8 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
3	5.05	5.07	43.02	44.55
4	3.73	3.74	40.71	40.57
5	2.63	2.68	263.72	263.00
6	8.08	8.44	321.20	321.33
7	7.37	7.17	13.28	15.05
8	10.17	10.27	31.35	30.36
9	11.23	11.24	35.87	36.27
10	11.51	11.49	41.64	42.16
11	11.85	12.01	30.84	30.33
12	6.13	6.13	34.78	35.30
13	7.31	7.38	15.13	15.14
14	12.74	12.79	39.45	38.86
15	17.12	17.25	48.39	48.28
16	16.10	15.99	41.23	42.04
17	12.61	12.94	45.92	45.35
18	8.04	7.82	28.53	29.35
19	20.95	21.14	284.43	284.57
20	36.05	36.17	283.41	283.25
21	47.00	47.07	292.27	292.27
22	55.02	55.10	292.02	291.96
23	59.75	59.96	287.30	287.20
24	63.66	63.62	282.32	282.17
25	63.95	64.03	284.07	284.20
26	63.59	64.01	285.95	285.89
27	60.72	60.86	280.37	280.26
28	57.99	58.25	284.10	284.16
29	63.13	63.24	279.77	279.63
30	73.37	73.53	282.04	282.03
31	63.29	63.24	276.87	276.65
32	68.42	68.60	274.23	274.15
33	72.88	72.67	283.71	283.70
34	60.09	60.23	284.17	284.19
35	52.06	51.94	271.94	272.04
36	44.40	44.58	276.03	276.04
37	48.03	47.80	263.14	263.34
38	54.37	54.65	265.29	265.29
39	58.15	58.22	258.60	258.72
40	48.13	48.21	270.11	270.11
41	30.80	30.84	273.50	273.30
42	23.57	23.55	274.10	273.04

LAUNCH 1 (Cont'd)

8 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
43	32.31	32.63	257.15	257.39
44	33.05	33.06	268.88	268.50
45	28.61	28.78	289.68	288.78
46	23.45	23.54	290.78	291.67
47	20.42	20.67	277.45	277.06
48	16.11	16.37	265.15	264.21
49	16.12	16.15	277.95	278.11
50	5.87	5.87	293.10	293.17
51	3.07	3.22	258.67	251.89
52	10.80	11.06	297.91	299.95
53	11.93	11.72	289.00	285.79
54	15.14	15.16	290.13	290.96
55	15.93	16.10	267.65	267.84
56	16.77	16.66	273.50	273.33
57	18.61	18.46	274.11	274.30
58	15.28	15.48	271.34	271.05
59	19.49	19.79	274.67	273.71
60	31.25	31.38	273.62	273.76
61	32.43	32.20	269.34	270.34

TABLE 4
LAUNCH 2
8 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
4	3.36	3.28	32.03	32.58
5	4.52	4.60	29.12	31.04
6	3.23	3.15	20.92	23.23
7	3.76	3.88	299.41	299.88
8	5.75	5.63	309.32	309.44
9	5.25	5.37	359.02	358.41
10	7.19	7.13	14.83	15.85
11	9.10	9.15	38.32	38.35
12	11.09	11.10	54.40	54.87
13	14.42	14.61	51.05	49.36
14	13.84	13.83	47.11	47.95
15	11.67	11.65	47.38	47.44
16	9.24	9.27	38.08	37.96
17	6.09	6.10	38.96	38.50
18	6.80	6.81	37.80	37.97
19	10.33	10.36	42.49	42.61
20	13.24	13.44	55.47	54.58
21	15.07	15.07	58.21	58.75
22	15.95	15.96	60.13	60.22
23	13.30	13.21	62.73	63.00
24	12.64	12.81	57.06	56.55
25	13.70	13.73	49.41	49.51
26	13.26	13.17	57.00	57.07
27	8.03	8.04	56.10	55.74
28	6.98	6.98	345.94	345.58
29	11.87	11.91	314.35	314.07
30	12.30	12.41	308.70	308.79
31	19.12	19.22	296.92	296.31
32	23.65	23.73	294.92	295.19
33	30.59	30.80	293.59	293.81
34	37.98	38.18	286.03	285.64
35	45.95	46.18	279.22	279.19
36	50.72	50.84	280.57	280.56
37	53.70	53.82	280.32	280.16
38	58.05	58.10	280.71	280.52
39	58.81	58.99	280.40	280.46
40	55.21	55.16	282.48	282.52
41	54.06	53.99	280.35	280.31

LAUNCH 2 (Cont'd)

8 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
42	56.96	57.23	275.15	274.91
43	64.37	64.71	274.37	274.31
44	73.51	73.58	276.99	276.96
45	73.57	73.79	279.16	279.19
46	72.51	72.64	284.18	284.24
47	67.77	67.77	278.61	278.40
48	68.72	68.84	276.92	277.04
49	56.97	56.64	265.87	265.68
50	63.83	63.93	270.98	271.22
51	58.02	58.14	284.79	284.72
52	53.57	53.86	279.48	279.36
53	49.76	49.46	269.11	269.24
54	46.34	46.10	262.01	261.59
55	39.59	39.88	257.30	257.48
56	40.03	39.91	261.61	261.33
57	49.52	49.71	257.88	257.89
58	50.26	50.53	265.85	265.72
59	43.02	43.06	271.47	270.71
60	44.62	44.43	267.91	268.13
61	49.11	49.44	267.96	268.04
62	40.89	40.90	270.16	269.56
63	32.71	32.48	258.76	258.99
64	28.18	28.46	255.21	255.06
65	25.22	25.34	261.28	261.11
66	35.83	36.07	260.19	259.97
67	41.64	41.54	260.93	260.44
68	37.14	37.22	282.59	282.05
69	27.14	27.27	287.95	287.89
70	19.97	20.08	286.91	286.14
71	21.00	21.00	291.69	292.47
72	16.96	16.98	270.23	270.95
73	20.92	21.05	260.58	261.25
74	21.72	21.46	261.74	261.35
75	19.17	19.22	257.58	256.97
76	23.08	23.05	275.29	275.54
77	15.79	16.22	290.12	288.84
78	14.28	13.94	301.87	302.00
79	7.26	7.37	268.32	270.64
80	14.12	14.30	239.12	238.35
81	14.45	14.52	317.57	316.81

LAUNCH 2 (Cont'd)

8 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
82	8.54	8.35	301.82	302.75
83	12.81	12.94	273.23	274.35
84	12.56	12.33	283.09	283.61
85	12.30	12.50	269.71	269.47
86	14.31	14.49	282.04	280.53
87	10.82	10.86	311.94	311.77
88	6.97	6.71	261.17	261.63
89	12.05	12.27	269.93	270.25
90	14.44	14.48	276.53	275.57
91	12.42	12.36	262.72	265.40
92	19.44	19.84	261.41	258.79
93	20.09	19.68	268.80	271.38

TABLE 5

LAUNCH 3

8 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
4	3.43	2.98	302.82	299.58
5	4.96	5.43	273.03	272.19
6	0.59	1.06	156.69	126.29
7	8.16	8.22	102.58	100.61
8	7.89	7.95	80.72	81.75
9	8.87	9.14	72.87	72.48
10	13.56	13.62	79.34	79.31
11	11.87	11.76	60.33	59.91
12	10.27	10.45	54.76	53.81
13	14.49	14.84	78.16	79.19
14	19.74	19.90	71.94	71.29
15	22.45	22.42	72.34	71.92
16	21.12	21.15	74.68	75.01
17	16.67	16.85	82.44	83.81
18	16.54	16.11	85.19	84.52
19	14.59	14.46	81.04	80.32
20	11.88	12.09	56.29	54.83
21	11.53	11.18	33.94	32.80
22	9.00	9.20	309.76	307.24
23	17.63	18.37	280.77	279.97
24	32.90	33.88	273.85	274.23
25	38.28	38.59	278.30	278.22
26	41.31	41.44	284.14	283.67
27	49.49	49.91	280.06	280.51
28	49.97	49.79	285.21	285.45
29	40.96	40.83	287.44	286.94
30	37.62	37.63	288.62	288.35
31	39.47	39.44	276.18	275.92
32	45.39	46.15	267.94	267.77
33	42.20	42.06	275.15	275.51
34	46.37	47.01	285.70	285.99
35	59.85	60.27	279.84	279.25
36	59.76	59.92	276.34	276.27
37	57.18	56.69	276.48	276.55
38	49.16	48.75	269.02	268.09
39	46.56	46.71	260.90	260.65
40	55.50	56.23	262.69	263.52
41	50.27	49.22	277.98	278.61
42	36.39	36.52	280.98	280.64
43	34.81	34.80	266.25	265.49
44	38.03	38.76	254.16	253.28

LAUNCH 3 (Cont'd)

8 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
45	50.00	50.21	255.54	255.87
46	43.78	43.23	263.29	263.73
47	37.11	37.15	263.59	262.86
48	38.91	38.87	265.91	266.34
49	35.31	35.42	263.15	262.89
50	33.76	33.72	263.70	264.10
51	32.09	31.89	264.88	264.31
52	34.61	35.08	252.22	252.30
53	42.86	43.10	255.36	255.23
54	40.27	39.77	267.82	268.49
55	29.16	28.69	283.24	283.91
56	20.34	20.73	274.66	273.49
57	29.87	30.08	270.23	270.55
58	25.57	25.55	268.03	266.87
59	30.63	30.94	268.08	268.02
60	30.90	30.83	273.77	274.81
61	24.46	24.00	290.00	289.47
62	19.70	19.87	290.66	291.73
63	11.41	10.66	310.32	314.30
64	4.78	4.40	351.22	345.01
65	12.47	12.98	249.85	250.21
66	20.72	20.45	270.97	272.35
67	5.39	4.68	317.12	313.19
68	9.69	9.96	274.53	276.15
69	13.24	13.40	294.10	293.43
70	11.30	10.67	285.71	284.08
71	8.05	8.50	241.08	244.17
72	18.08	18.78	266.89	266.25
73	23.72	23.82	260.61	260.71
74	22.85	22.48	279.86	280.82
75	22.62	23.07	279.59	279.13
76	22.17	22.29	287.54	287.46
77	21.95	22.05	278.93	278.27
78	24.36	23.91	276.96	277.39
79	21.82	21.53	275.31	274.68

TABLE 6

LAUNCH 1

9 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
4	3.38	3.36	213.70	214.53
5	7.16	7.39	218.41	218.40
6	12.50	12.33	219.92	217.66
7	8.50	8.50	185.63	186.85
8	5.88	5.84	151.25	151.59
9	7.07	7.30	117.75	116.90
10	10.13	10.08	110.40	110.70
11	7.89	7.63	85.67	85.30
12	8.21	8.36	112.38	111.68
13	9.86	9.81	107.00	107.88
14	10.11	9.97	125.36	124.65
15	11.78	11.79	92.18	91.77
16	12.00	11.98	87.60	87.40
17	8.99	8.98	86.61	86.31
18	5.25	5.30	48.38	49.45
19	5.03	5.04	45.27	43.21
20	3.02	3.02	323.84	321.67
21	6.99	7.16	306.63	305.49
22	17.42	17.48	298.40	298.27
23	23.66	23.84	293.25	293.52
24	29.93	30.02	293.08	292.93
25	33.39	33.30	300.16	300.28
26	26.83	26.96	301.54	301.47
27	31.42	31.50	301.63	301.53
28	36.45	36.50	303.80	303.88
29	32.11	31.95	306.67	306.50
30	31.68	31.72	304.06	303.90
31	32.76	33.04	299.84	299.72
32	34.01	33.98	291.10	291.00
33	48.12	48.43	280.35	280.39
34	53.30	53.28	284.34	284.34
35	50.96	50.98	296.64	296.67
36	42.29	42.28	299.04	298.88
37	47.07	47.26	282.21	282.21
38	35.75	35.56	287.04	287.14
39	36.97	37.05	282.91	282.79
40	32.53	32.60	272.47	272.34
41	36.02	36.29	267.55	267.90
42	34.49	34.15	282.19	282.15
43	32.40	32.66	268.00	267.88
44	38.28	38.44	259.81	259.89
45	35.08	34.89	274.44	274.33

LAUNCH 1 (Cont'd)

9 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
46	27.79	27.71	275.65	275.93
47	27.69	27.49	284.54	284.60
48	24.25	24.49	283.75	284.01
49	38.68	38.62	290.80	290.66
50	25.53	26.40	297.25	296.86
51	21.58	21.17	297.67	297.57
52	20.08	20.05	302.38	302.47
53	15.84	15.96	310.40	310.34
54	14.67	14.80	288.27	288.00
55	15.38	15.40	284.88	284.93
56	14.24	14.47	259.32	259.19
57	12.50	12.08	285.69	285.49
58	8.96	9.02	292.75	293.30
59	10.97	11.26	262.09	262.70
60	1.35	1.31	238.02	237.86
61	8.13	7.90	257.57	256.88
62	11.96	12.05	271.51	270.74
63	7.30	7.46	346.58	345.73
64	4.97	5.04	266.06	268.95
65	8.41	8.50	253.66	252.42
66	8.66	8.66	273.43	272.31
67	15.98	16.02	272.67	273.72
68	16.53	16.67	278.33	278.20
69	19.45	19.77	270.40	270.13
70	33.62	34.01	266.20	266.08
71	36.66	36.49	266.52	266.29
72	37.10	37.24	270.91	270.55
73	42.65	42.68	269.38	269.41
74	34.71	34.54	283.54	283.23
75	49.01	49.66	281.28	281.39
76	45.33	45.08	280.05	279.60
77	49.80	49.75	262.91	263.19
78	47.23	46.99	261.41	261.20
79	51.02	51.28	262.24	262.31
80	58.95	59.27	273.41	273.38
81	56.11	56.31	250.30	249.85
82	53.66	53.38	259.80	259.75

TABLE 7

LAUNCH 2

9 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
3	9.33	9.36	171.43	171.68
4	8.22	8.16	174.14	174.64
5	6.24	6.26	189.31	190.56
6	8.27	8.37	226.80	226.94
7	9.50	9.62	207.74	206.72
8	7.77	7.85	172.16	171.24
9	11.62	11.63	151.89	151.99
10	7.53	7.59	150.28	150.40
11	5.81	5.86	144.09	142.69
12	5.27	5.16	145.13	147.94
13	3.94	4.01	141.63	140.64
14	3.60	3.63	138.54	137.27
15	4.27	4.29	116.28	117.00
16	0.61	0.56	152.89	166.89
17	2.03	1.96	230.11	229.59
18	9.01	9.17	278.74	278.94
19	16.51	16.66	285.96	286.06
20	18.63	18.78	285.02	285.22
21	21.78	21.87	287.54	287.38
22	22.16	22.31	294.69	294.69
23	24.94	24.90	299.24	299.29
24	27.96	28.07	288.91	288.76
25	30.98	31.13	291.29	291.28
26	31.84	31.86	283.58	283.59
27	32.44	32.58	283.64	283.58
28	35.68	35.63	284.41	284.48
29	37.72	38.01	285.80	285.72
30	42.32	42.23	284.46	284.43
31	43.95	44.14	278.42	278.38
32	48.16	48.21	281.11	281.11
33	53.57	53.66	296.11	296.26
34	59.29	59.40	301.51	301.47
35	59.32	59.52	306.21	306.34
36	56.66	56.60	306.05	306.27
37	53.90	54.12	303.65	303.57
38	51.56	51.41	303.46	303.45
39	43.22	43.36	297.91	297.86
40	40.92	40.94	284.02	283.82
41	36.91	36.60	279.29	279.27
42	28.74	28.80	282.25	282.41
43	37.32	37.71	267.01	266.90

LAUNCH 2 (Cont'd)

9 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
44	49.79	49.94	273.02	272.94
45	56.46	56.52	278.73	278.74
46	49.20	49.30	280.29	280.40
47	49.88	49.99	281.94	281.66
48	48.73	48.63	285.42	285.31
49	45.79	45.66	280.52	280.49
50	44.95	45.13	279.44	278.92
51	39.80	39.71	280.23	280.25
52	42.98	43.18	272.16	272.45
53	44.23	44.24	267.30	266.83
54	46.82	47.17	273.34	273.38
55	46.24	46.08	279.31	279.04
56	39.49	39.18	284.44	284.56
57	31.71	31.78	294.47	294.20
58	34.79	34.79	298.02	298.04
59	29.47	29.66	293.45	293.16
60	24.48	24.43	288.70	289.07
61	25.04	24.91	285.69	285.72
62	29.82	29.80	284.89	284.59
63	28.93	29.00	288.85	288.69
64	22.42	22.76	288.68	289.50
65	19.46	19.27	270.06	269.11
66	20.10	20.26	267.83	267.55
67	14.74	14.81	289.30	289.78
68	13.78	13.68	287.02	286.24
69	13.19	13.12	268.37	270.21
70	18.18	18.38	259.35	258.09
71	17.34	17.55	258.38	258.42
72	21.13	21.07	270.79	271.39
73	18.62	18.65	283.14	282.15
74	18.33	18.30	295.38	294.84
75	14.63	14.56	304.51	304.96
76	14.19	14.28	292.90	292.00
77	9.91	9.63	290.89	289.61
78	16.82	16.96	283.78	286.12
79	12.09	12.24	270.12	270.46
80	9.83	9.61	231.47	232.67
81	15.45	15.66	259.86	256.86
82	10.92	11.17	298.23	299.10
83	11.45	11.68	318.86	320.09

TABLE 8

LAUNCH 1

10 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
4	13.97	13.65	222.77	224.06
5	15.52	15.63	231.46	231.06
6	22.61	22.73	211.76	211.03
7	24.96	25.13	210.25	210.86
8	27.01	27.01	205.27	205.23
9	25.24	25.22	201.59	201.61
10	21.17	21.34	204.94	205.41
11	24.32	24.16	215.28	215.71
12	23.04	23.17	218.16	218.01
13	24.48	24.36	222.41	222.55
14	30.78	31.26	224.45	224.61
15	36.92	37.11	229.29	229.37
16	47.71	47.94	227.56	227.38
17	49.24	49.25	223.80	223.81
18	53.36	53.79	233.44	233.72
19	71.72	72.08	235.99	236.09
20	75.20	75.26	234.91	234.85
21	76.75	77.01	235.19	235.25
22	80.05	79.88	237.03	237.12
23	78.16	78.36	239.10	239.17
24	74.67	74.70	244.58	244.68
25	82.48	82.47	248.22	248.31
26	81.79	81.85	248.55	248.43
27	83.22	83.39	247.12	247.14
28	83.32	83.39	246.27	246.23
29	85.96	86.21	246.25	246.21
30	86.15	86.18	246.41	246.36
31	86.91	87.10	243.46	243.58
32	86.08	85.96	241.95	241.91
33	85.69	85.49	241.91	241.85
34	83.46	83.44	241.10	240.91
35	82.27	82.54	242.85	242.91
36	82.93	83.08	241.66	241.76
37	81.84	81.73	238.99	239.10
38	82.72	82.70	235.64	235.72
39	85.04	85.62	239.65	239.58
40	90.77	90.36	247.20	247.41
41	82.37	82.29	253.66	253.58
42	74.72	74.43	253.27	253.36
43	63.13	63.06	252.95	252.97
44	60.48	60.66	246.54	246.32

LAUNCH 1 (Cont'd)

10 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
45	62.94	62.95	243.54	243.50
46	58.84	58.81	251.58	251.67
47	50.98	50.79	266.79	267.52
48	40.49	40.17	264.73	264.20
49	41.54	42.07	265.77	267.01
50	42.49	42.03	266.12	264.49
51	38.42	38.68	266.92	267.65
52	33.55	33.27	271.20	270.94
53	35.15	35.16	279.09	278.73
54	40.89	41.23	279.23	279.76
55	39.97	39.71	283.74	284.04
56	38.63	38.96	272.55	272.81
57	36.94	37.00	268.58	267.77
58	35.60	35.64	268.05	268.35
59	35.39	35.06	271.94	271.91
60	31.34	31.90	269.86	271.22
61	33.21	32.73	287.03	286.88
62	26.90	26.61	305.35	305.60
63	19.09	19.04	303.49	302.58
64	24.84	25.05	289.98	289.36
65	33.65	33.34	292.36	292.32
66	28.97	28.85	285.51	285.08
67	24.73	24.84	299.99	301.38
68	3.02	2.49	319.11	321.47
69	4.37	4.72	289.79	289.43
70	14.02	14.11	279.31	275.63
71	21.13	21.63	280.62	283.60
72	17.05	16.80	301.61	302.20
73	8.31	8.52	290.52	289.10
74	11.22	11.13	297.37	295.68
75	13.44	13.28	317.38	318.74
76	6.79	6.95	297.61	297.77
77	0.82	0.78	269.69	247.10
78	11.52	11.08	206.03	209.03
79	8.30	7.92	251.85	245.50
80	8.08	8.43	275.12	275.68
81	7.69	8.20	285.44	286.16
82	12.92	12.60	299.18	300.00
83	10.61	10.82	280.51	276.71
84	9.60	9.42	266.09	266.88
85	13.22	13.31	244.38	242.01
86	8.16	8.49	282.22	283.05
87	8.55	8.49	278.73	278.63
88	10.53	10.61	268.79	270.93

TABLE 9

LAUNCH 2

10 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
6	16.63	16.68	230.76	230.55
7	22.99	23.08	210.41	210.54
8	20.72	20.74	201.65	201.44
9	18.93	18.96	195.98	196.13
10	19.03	19.07	196.81	196.71
11	25.22	25.34	186.44	186.30
12	27.79	27.82	197.98	198.37
13	26.85	26.73	216.85	216.79
14	36.66	37.63	225.16	225.52
15	40.27	39.91	223.08	222.86
16	47.44	47.79	229.68	229.79
17	57.15	57.18	234.63	234.67
18	63.51	63.43	234.37	234.35
19	62.05	62.22	234.98	235.02
20	66.44	66.38	242.21	242.22
21	75.80	75.81	246.38	246.38
22	81.46	81.81	245.81	245.79
23	80.43	80.40	243.47	243.52
24	81.56	81.62	239.06	239.17
25	85.00	85.13	233.69	233.78
26	83.33	83.38	233.65	233.59
27	84.92	85.10	234.56	234.61
28	86.41	86.42	235.19	235.18
29	86.86	86.75	236.01	235.92
30	85.59	85.73	235.69	235.80
31	88.10	87.98	235.74	235.89
32	84.21	84.23	233.07	232.91
33	84.09	84.21	229.44	229.46
34	84.10	84.17	228.39	228.32
35	85.15	85.34	225.25	225.38
36	88.59	88.73	230.01	230.01
37	90.73	90.39	233.93	233.88
38	90.01	90.31	236.29	236.23
39	90.47	90.49	236.61	236.70

TABLE 10

LAUNCH 3

10 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
7	13.20	13.38	233.40	234.10
8	16.48	16.16	232.48	231.89
9	18.67	18.71	233.43	233.14
10	23.26	23.20	232.53	233.08
11	22.51	22.57	238.78	238.78
12	32.81	32.74	236.91	236.55
13	36.20	35.83	241.94	241.96
14	39.97	39.93	235.47	235.90
15	41.95	41.85	231.22	231.12
16	43.99	43.99	235.55	235.39
17	53.76	53.50	238.69	238.68
18	62.89	62.76	234.39	234.50
19	66.65	66.38	234.96	234.90
20	73.93	74.00	238.06	238.03
21	75.87	75.91	241.92	242.01
22	83.08	82.78	239.21	239.20
23	91.68	91.63	235.98	236.09
24	92.60	92.98	231.22	231.35
25	91.85	91.89	232.80	232.71
26	86.10	86.37	234.91	234.74
27	78.38	78.64	233.91	234.18
28	71.03	71.43	230.67	230.70
29	71.13	70.96	229.05	229.11
30	71.77	72.06	234.28	234.07
31	66.98	67.40	238.13	237.98
32	55.46	55.55	240.47	240.27
33	50.27	50.50	244.25	244.52
34	41.51	42.02	252.81	251.56
35	31.73	31.77	265.54	266.05
36	39.88	39.69	254.40	254.36
37	43.89	43.49	254.01	254.40
38	40.41	41.15	262.85	262.87
39	38.80	38.75	262.90	262.50
40	30.36	30.26	267.40	267.50
41	35.17	35.15	269.91	269.69
42	34.18	34.28	272.66	272.66
43	39.67	39.39	275.23	274.80
44	34.98	35.23	272.73	272.98

LAUNCH 3 (Cont'd)

10 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
45	32.52	32.72	276.18	276.50
46	35.65	35.62	276.59	276.40
47	31.48	31.90	290.27	289.86
48	22.02	22.19	288.22	288.39
49	29.14	28.58	295.60	295.12
50	23.10	23.44	292.04	293.14
51	22.37	22.63	269.32	269.04
52	14.90	14.62	282.81	280.71
53	25.40	24.99	271.59	272.45
54	23.87	24.31	287.67	286.30
55	17.85	18.10	279.96	281.28
56	14.86	15.12	284.03	284.22
57	10.80	10.84	278.20	279.19

TABLE 11

LAUNCH 2

11 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
8	35.29	35.43		
9	40.17	40.21	340.92	340.95
10	34.94	35.05	342.95	343.12
11	37.62	37.61	348.50	348.45
12	41.13	41.09	344.67	344.93
13	37.72	37.90	340.20	340.00
14	37.42	37.12	340.25	340.28
15	34.11	34.29	337.73	337.82
16	32.42	32.45	336.44	336.45
17	29.93	29.95	334.08	334.25
18	33.07	33.11	337.80	337.75
19	33.46	33.32	334.75	334.64
20	32.97	33.27	329.65	329.82
21	36.63	36.55	318.39	318.69
22	35.10	35.16	308.46	308.19
23	33.33	33.32	312.54	312.78
24	36.38	36.41	321.90	321.72
25	37.75	37.78	309.64	309.58
26	39.66	39.97	291.31	291.37
27	41.09	41.25	284.35	283.92
28	49.31	49.60	277.25	277.64
29	50.62	50.53	275.18	274.87
30	55.69	55.78	269.44	269.40
31	71.01	70.92	262.77	262.89
32	73.97	74.22	262.45	262.73
33	76.85	76.92	265.12	264.95
34	68.85	68.85	270.48	270.59
35	57.55	57.48	271.63	271.70
36	63.04	63.27	273.83	273.49
37	79.26	79.46	251.96	252.03
38	74.34	74.17	253.90	254.09
39	56.75	56.75	274.97	275.18
40	50.37	50.01	276.22	275.61
41	49.12	49.31	268.60	268.87
42	45.52	45.55	272.17	272.19
43	44.68	44.69	269.12	268.93
44	47.05	46.97	262.14	262.37
			257.77	258.07

LAUNCH 2 (cont'd)

11 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
45	46.16	46.08	260.52	260.91
46	44.74	44.64	270.80	271.01
47	36.37	36.56	265.92	265.85
48	40.43	42.06	278.06	272.44
49	36.46	36.38	287.09	287.70
50	25.21	25.42	272.58	271.80
51	20.27	20.02	254.27	254.61
52	21.64	22.22	240.61	239.99
53	37.06	37.31	251.56	251.80
54	33.07	32.97	268.06	268.47
55	27.76	27.75	271.00	271.13
56	24.33	24.14	277.17	276.63
57	19.04	19.02	291.53	291.73
58	19.32	19.19	303.50	302.88
59	7.46	7.55	277.42	279.45
60	12.59	12.71	225.29	224.68
61	13.48	12.95	240.50	242.51
62	11.10	11.11	251.82	250.31
63	6.85	7.12	214.84	216.07
64	17.11	17.21	251.71	252.33
65	11.16	11.08	239.52	239.56
66	12.53	13.03	248.44	247.42
67	17.79	17.91	276.74	276.37
68	14.98	14.83	308.08	308.56
69	11.69	11.48	291.06	292.62
70	15.11	15.32	262.28	261.45
71	15.60	15.76	251.17	250.88
72	23.03	23.44	250.80	251.56
73	27.69	27.48	267.48	265.99
74	34.74	34.95	267.38	268.43
75	35.85	35.69	275.43	275.04
76	25.69	25.72	273.47	274.88

TABLE 12
LAUNCH 3
11 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
2	17.66	17.95	295.12	294.77
3	21.41	21.49	286.27	286.57
4	24.41	24.37	307.85	307.94
5	21.57	21.79	322.80	323.05
6	25.43	25.51	332.92	332.97
7	30.91	31.17	333.16	333.16
8	30.66	30.37	323.47	323.59
9	26.17	26.27	328.40	328.17
10	29.13	29.38	322.20	322.23
11	30.74	30.59	326.84	326.92
12	28.66	28.81	319.24	319.13
13	25.57	25.54	312.23	312.35
14	30.43	30.19	319.36	319.31
15	30.81	30.82	308.70	308.75
16	26.93	27.35	294.52	294.40
17	28.72	28.74	294.44	294.97
18	23.23	22.95	288.88	288.59
19	19.95	20.04	285.99	286.24
20	22.35	22.39	280.41	280.20
21	22.39	22.49	274.15	274.07
22	26.62	26.89	272.05	271.49
23	31.66	31.63	266.66	266.83
24	36.68	36.90	272.35	272.11
25	40.45	40.41	281.86	281.98
26	45.49	45.79	261.04	260.86
27	60.24	60.36	254.68	254.60
28	63.52	63.61	254.23	254.36
29	68.80	68.85	260.07	260.24
30	61.42	61.09	257.18	257.15
31	68.90	69.47	243.70	243.53
32	87.26	87.73	243.87	243.90
33	85.91	86.08	256.38	256.63
34	65.09	64.70	266.95	267.07
35	47.43	47.36	274.21	274.36
36	45.97	46.04	285.84	285.68
37	38.95	38.73	277.10	277.15
38	45.43	45.87	255.18	255.10
39	53.96	53.93	257.25	257.69
40	57.37	57.24	266.27	266.19
41	54.30	54.51	265.29	265.43
42	46.87	46.59	268.80	268.46
43	48.57	48.62	265.12	265.11
44	49.90	50.00	271.26	271.57

LAUNCH 3 (Cont'd)

11 February 1977

Time	Speed Knots		Direction Deg	
	FPS-16	Nike	FPS-16	Nike
45	40.32	40.24	273.56	272.90
46	25.06	24.96	269.59	269.99
47	30.32	30.45	251.23	250.62
48	38.41	38.51	239.97	240.50
49	39.07	38.92	247.76	247.44
50	31.40	31.49	254.81	255.13
51	29.95	30.03	256.79	256.34
52	25.71	25.95	267.78	267.32
53	26.42	26.17	269.99	270.51
54	16.50	16.60	263.50	263.83
55	7.64	7.91	208.10	207.47
56	10.74	10.87	260.17	257.49
57	12.38	12.20	270.81	272.53
58	19.39	19.49	255.30	255.59
59	23.23	23.36	266.05	266.13
60	11.19	11.03	233.21	231.95
61	16.86	17.30	271.71	272.72
62	16.09	15.46	311.68	310.98
63	13.18	13.16	279.22	281.43
64	12.00	12.31	290.73	291.07
65	6.08	5.77	245.54	241.93
66	8.15	8.35	232.91	233.29
67	14.80	15.33	255.21	253.70
68	25.50	25.42	249.20	250.45
69	26.31	26.10	257.89	258.35
70	24.47	24.81	272.05	271.94
71	25.76	25.55	279.94	279.88
72	31.69	31.73	274.63	274.33
73	32.61	32.93	262.31	262.58
74	42.04	42.44	254.32	254.03

TABLE 13

LAUNCH 1

7 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
6	2379.5	2360.2	7.11	7.14	-6.24	-6.27
7	2538.2	2520.2	8.66	8.41	-8.12	-7.87
8	2713.0	2699.1	8.43	8.38	-5.86	-5.86
9	2885.8	2873.2	4.15	4.23	-5.19	-5.23
10	3055.4	3045.4	1.60	1.45	0.27	0.34
11	3248.8	3240.4	-1.66	-1.49	0.86	0.62
12	3449.8	3442.4	-3.21	-3.26	3.48	3.51
13	3652.0	3636.1	-2.12	-2.03	5.69	5.57
14	3855.9	3834.9	-0.65	-0.81	6.97	7.05
15	4065.9	4049.5	1.68	1.74	10.69	10.43
16	4278.3	4262.3	1.13	0.97	15.47	15.62
17	4479.4	4464.8	1.90	2.05	17.05	16.76
18	4683.3	4667.7	-2.38	-2.35	18.34	18.48
19	4885.8	4867.4	-3.02	-3.01	18.60	18.45
20	5073.1	5052.9	-3.67	-3.62	15.47	15.40
21	5253.5	5233.6	-4.17	-4.15	15.42	15.46
22	5443.6	5425.1	-0.85	-0.95	15.38	15.31
23	5631.3	5611.7	-1.84	-1.78	14.79	14.66
24	5812.4	5791.6	-2.02	-2.05	12.66	12.71
25	5989.7	5969.7	-1.51	-1.44	14.20	14.16
26	6167.9	6149.5	-0.49	-0.63	12.08	12.26
27	6352.0	6339.0	-1.20	-1.29	9.83	10.07
28	6541.5	6531.9	-2.42	-2.41	8.90	8.94
29	6730.9	6725.7	-0.28	-0.21	9.37	9.71
30	6915.1	6913.9	4.38	4.31	9.00	8.74
31	7101.1	7099.2	5.57	5.38	9.58	9.70
32	7297.3	7293.8	5.91	5.90	10.89	10.89
33	7503.1	7497.2	4.45	4.41	12.27	12.21
34	7706.4	7698.7	5.79	5.80	15.12	15.03
35	7893.2	7882.7	8.18	8.08	15.54	15.36
36	8084.5	8074.0	6.89	6.96	14.34	14.41
37	8275.3	8266.9	2.17	2.33	17.25	17.19
38	8458.7	8446.4	-1.08	-1.09	18.23	17.82
39	8644.5	8627.3	-8.31	-8.12	29.21	28.93
40	8814.6	8799.8	-14.62	-14.44	34.61	34.85
41	8973.7	8962.5	-19.31	-19.42	39.45	39.35
42	9126.5	9117.5	-20.50	-20.50	43.75	43.94
43	9279.7	9273.2	-18.76	-18.63	41.21	41.39
44	9450.1	9445.3	-12.28	-12.39	43.24	43.27
45	9627.9	9624.1	-13.44	-13.52	51.13	50.81

LAUNCH 1 (Cont)

7 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
46	9802.0	9797.5	-17.83	-17.72	49.80	49.92
47	9978.3	9974.2	-19.39	-19.35	54.19	54.09
48	10147.7	10148.1	-24.27	-24.05	55.45	55.44
49	10311.2	10314.1	-26.72	26.62	51.64	51.76
50	10483.3	10483.6	-20.38	-20.46	51.96	51.56
51	10673.6	10673.4	-17.99	-17.98	59.74	59.79
52	10858.5	10862.5	-23.26	-23.21	67.77	67.51
53	11029.7	11036.0	-28.36	-28.38	64.03	64.26
54	11199.1	11206.9	-28.13	-27.94	57.83	57.78
55	11375.2	11383.8	-26.96	-26.99	53.45	53.50
56	11553.6	11563.5	-19.29	-19.45	45.66	45.65
57	11729.4	11741.9	-20.40	-20.31	48.51	48.46
58	11900.9	11916.6	-18.41	-18.32	51.68	51.58
59	12064.5	12080.2	-23.78	-23.33	52.61	52.46
60	12225.8	12236.2	-21.16	-21.04	54.31	54.39
61	12387.9	12401.5	-21.80	-21.70	57.88	57.79
62	12562.5	12581.7	-27.79	-27.77	59.92	60.15
63	12748.6	12767.7	-23.53	-23.44	62.67	62.57
64	12929.5	12951.1	-28.43	-28.35	65.11	64.90
65	13136.7	13157.9	-24.54	-24.40	62.67	63.07
66	13351.1	13374.5	-26.98	-27.17	53.03	52.91
67	13538.5	13565.0	-25.19	-25.05	56.10	56.10
68	13714.5	13749.6	-21.37	-21.02	59.11	58.91
69	13889.1	13927.5	-22.05	-22.42	62.21	62.27
70	14079.9	14114.4	-23.33	-23.25	62.35	62.30
71	14275.7	14313.6	-25.53	-25.18	57.27	57.39
72	14458.8	14507.4	-30.07	-29.91	54.73	54.67
73	14634.8	14689.3	-26.50	-27.07	53.17	53.11
74	14828.1	14862.7	-24.37	-24.13	52.70	52.95
75	15042.6	15067.7	-22.29	-21.94	46.17	46.02
76	15246.0	15291.0	-21.27	-21.26	53.55	53.30
77	15448.5	15498.5	-21.06	-21.78	52.25	52.41
78	15646.7	15686.2	-19.33	-18.56	50.17	50.39
79	15842.5	15873.7	-19.51	-19.61	43.23	43.24
80	16036.4	16064.6	-14.94	-14.91	42.67	42.63
81	16214.6	16250.6	-12.51	-12.48	45.90	45.80
82	16407.7	16448.3	-16.72	-16.55	44.86	44.96
83	16610.0	16659.4	-17.83	-18.20	36.95	36.74
84	16806.2	16870.1	-16.77	-15.83	32.27	32.29

LAUNCH 1 (Cont)

7 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
85	17010.8	17073.0	-10.09	-9.90	32.63	32.88
86	17213.6	17278.6	-7.01	-8.27	35.37	34.62
87	17414.1	17491.4	-11.91	-12.09	41.86	41.62

H
 \bar{X} = - 7.6 meters
 σ = 24.9
 σ^2 = 621.33

N-S
 \bar{X} = - .017 knots
 σ = .263
 σ^2 = .069

E-W
 \bar{X} = .025 knots
 σ = .193
 σ^2 = .037

TABLE 14

LAUNCH 2

7 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
3	2005.7	2004.6	6.22	6.08	-7.74	-7.51
4	2244.1	2242.7	6.61	6.68	-8.76	-8.91
5	2492.8	2495.5	3.55	3.53	-6.39	-6.51
6	2753.9	2758.9	2.40	2.84	-0.41	-0.26
7	3011.6	3022.1	1.95	1.72	-6.25	-5.50
8	3268.4	3286.9	-0.66	-0.66	-3.19	-3.24
9	3536.3	3554.6	-3.44	-3.41	1.02	0.89
10	3728.4	3819.4	1.82	0.01	-0.51	4.10
11	3993.4	4083.7	0.72	2.52	16.99	12.30
12	4330.0	4346.7	1.53	1.48	15.63	15.68
13	4591.2	4606.4	-0.38	-0.16	19.23	19.11
14	4856.9	4866.9	-5.04	-4.89	17.20	17.06
15	5125.3	5134.5	-1.50	-1.62	15.80	16.00
16	5397.6	5409.6	0.37	0.51	13.27	13.45
17	5672.7	5686.1	0.51	0.46	8.87	8.82
18	5948.6	5961.0	1.11	1.10	8.60	8.36
19	6221.8	6232.7	-1.29	-1.21	12.98	13.06
20	6489.4	6501.7	-3.49	-3.51	13.07	13.14
21	6757.7	6771.9	-1.88	-1.95	8.63	8.64
22	7030.6	7044.4	0.40	0.49	6.40	6.35
23	7305.7	7317.7	0.36	0.24	10.36	10.26
24	7578.8	7590.7	4.38	4.39	8.17	8.19
25	7854.4	7866.1	6.27	6.36	7.49	7.37
26	8138.2	8148.7	2.22	2.15	12.13	12.01
27	8421.4	8432.4	-8.54	-8.37	29.61	29.55
28	8709.8	8709.4	-18.76	-18.46	38.21	37.29
29	8998.4	8986.0	-16.75	-16.82	37.91	37.88
30	9277.5	9268.1	-13.51	-13.44	42.38	42.35
31	9558.0	9549.9	-17.07	-17.00	50.87	50.71
32	9847.5	9837.7	-24.74	-24.45	51.50	51.53
33	10146.9	10137.0	-23.27	-23.26	56.91	56.65
34	10445.0	10433.5	-20.10	-19.97	67.67	67.55
35	10731.9	10719.7	-23.88	-23.77	68.01	68.19
36	11016.5	11006.1	-33.32	-33.06	50.91	59.03
37	11315.9	11307.5	-24.02	-24.11	54.67	54.68
38	11623.1	11614.0	-19.41	-19.22	57.72	57.68
39	11934.5	11926.5	-19.57	-19.58	54.74	54.64
40	12250.8	12243.7	-27.41	-27.27	61.80	61.58
41	12561.3	12558.1	-31.32	-31.37	61.09	61.26
42	12880.4	12881.4	-29.84	-29.76	56.96	56.89
43	13206.0	13206.2	-22.76	-22.66	62.29	62.21

LAUNCH 2 (Cont)

7 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
44	13525.2	13528.4	-23.24	-23.08	68.38	68.19
45	13855.2	13857.5	-28.24	-28.28	63.68	63.87
46	14175.0	14176.5	-24.50	-24.20	56.74	56.61
47	14482.6	14487.6	-23.23	-23.18	58.44	58.31
48	14805.9	14816.5	-22.74	-22.82	59.60	59.55
49	15136.9	15147.7	-24.69	-24.72	62.18	62.22
50	15477.1	15477.9	-23.34	-23.44	60.87	61.02
51	15824.5	15825.9	-23.72	-23.49	57.34	57.25
52	16180.4	16188.5	-24.96	-24.80	43.28	43.70
53	16529.5	16543.0	-21.23	-21.33	37.77	37.87
54	16857.1	16875.8	-14.26	-14.22	34.01	33.81
55	17193.0	17208.0	-9.60	-9.27	40.71	40.83
56	17535.8	17553.2	-18.74	-18.83	30.69	30.97
57	17891.8	17910.7	-11.57	-11.74	16.77	16.91
58	18259.7	18275.3	-5.11	-5.03	20.34	19.93
59	18615.7	18638.5	-5.35	-5.63	19.22	19.40
60	18975.3	19007.4	4.23	4.45	25.03	24.78
61	19333.5	19364.9	-3.37	-3.30	28.64	28.50
62	19687.4	19716.5	-4.83	-4.83	20.98	21.14
63	20065.8	20091.8	-8.85	-8.04	20.97	21.40
64	20453.9	20476.8	-15.94	-16.01	15.68	15.64
65	20839.7	20857.5	-10.12	-10.47	9.88	10.05
66	21206.8	21227.6	-11.50	-12.06	1.82	1.63
67	21567.6	21596.5	-2.36	-1.94	6.41	6.41
68	21962.9	21980.8	1.91	1.60	7.52	7.40
69	22348.8	22369.1	-0.60	-0.70	9.22	8.87
70	22724.8	22753.8	0.20	-0.09	10.41	10.44
71	23125.6	23143.9	1.11	1.11	12.89	13.07
72	23530.3	23542.5	2.72	3.50	13.18	13.19
73	23941.6	23963.1	8.63	8.12	21.20	20.74
74	24367.6	24400.2	3.10	3.54	24.01	24.16
75	24802.3	24831.4	8.25	7.68	32.13	31.91
76	25244.1	25264.3	3.80	4.17	35.07	34.82
77	25677.8	25693.0	-5.55	-5.43	36.58	36.58
78	26108.0	26122.5	-8.89	-8.80	35.04	35.27

\bar{X} = -10.75 meters
 σ = 18.3
 σ^2 = 336.66

\bar{X} = -.041 knots
 σ = .377
 σ^2 = .142

\bar{X} = .019 knots
 σ = .773
 σ^2 = .597

TABLE 15

LAUNCH 1

8 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
3	2187.4	2189.3	-3.61	-3.69	-3.56	-3.45
4	2495.4	2501.3	-2.84	-2.83	-2.44	-2.44
5	2802.9	2806.9	0.33	0.29	2.66	2.61
6	3115.2	3115.3	-6.59	-6.30	5.27	5.06
7	3430.7	3429.3	-6.92	-7.17	-1.86	-1.69
8	3743.3	3741.9	-8.86	-8.69	-5.19	-5.29
9	4054.4	4053.1	-9.06	-9.10	-6.65	-6.58
10	4364.6	4364.8	-8.51	-8.60	-7.71	-7.65
11	4679.0	4677.9	-10.36	-10.18	-6.06	-6.08
12	5001.1	4998.3	-5.00	-5.03	-3.54	-3.49
13	5333.3	5328.7	-7.12	-7.02	-1.93	-2.04
14	5668.4	5660.6	-9.96	-9.84	-8.02	-8.10
15	6005.9	5997.0	-11.48	-11.37	-12.87	-12.80
16	6346.0	6338.9	-11.88	-12.10	-10.71	-10.62
17	6691.6	6682.9	-9.09	-8.77	-9.21	-9.06
18	7044.7	7037.0	-6.81	-7.07	-3.83	-3.84
19	7406.9	7402.2	-5.32	-5.24	20.46	20.29
20	7780.4	7771.2	-11.93	-11.98	34.14	34.01
21	8158.7	8145.6	-17.84	-17.81	43.55	43.49
22	8535.9	8521.4	-20.61	-20.63	51.10	51.00
23	8915.0	8901.1	-17.73	-17.77	57.28	57.05
24	9305.6	9293.0	-13.41	-13.59	62.19	62.19
25	9703.1	9688.2	-15.71	-15.55	62.07	62.04
26	10096.1	10077.1	-17.53	-17.47	61.56	61.15
27	10488.2	10465.2	-10.84	-10.93	59.88	59.73
28	10887.5	10861.0	-14.25	-14.13	56.48	56.24
29	11295.9	11270.2	-11.58	-11.73	68.27	68.13
30	11700.4	11672.9	-16.64	-16.56	77.77	77.62
31	12092.6	12063.2	-7.91	-8.17	67.78	67.80
32	12494.4	12468.3	-4.97	-5.05	68.42	68.23
33	12912.2	12887.2	-17.21	-17.27	70.61	70.80
34	13333.3	13309.9	-14.77	-14.71	58.39	58.26
35	13748.5	13726.7	-1.85	-1.76	51.91	52.03
36	14171.6	14152.3	-4.69	-4.66	44.34	44.15
37	14614.8	14597.2	5.55	5.74	47.48	47.73
38	15053.4	15032.0	4.49	4.46	54.47	54.19
39	15465.0	15447.3	11.39	11.50	57.09	57.01
40	15867.6	15854.4	-0.09	-0.09	48.21	48.13
41	16291.3	16273.0	-1.78	-1.88	30.79	30.75
42	16715.0	16690.5	-1.25	-1.68	23.52	23.51

LAUNCH 1 (Cont)

8 February 1977

H MSL Meters			-N+S		Knots		-E+W		Knots	
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
43	17132.7	17114.3	7.12	7.19	31.85	31.50				
44	17569.9	17561.3	0.86	0.65	33.05	33.04				
45	18029.3	18015.9	-9.27	-9.63	27.24	26.93				
46	18496.3	18481.8	-8.69	-8.32	21.87	21.93				
47	18961.2	18949.7	-2.54	-2.65	20.51	20.25				
48	19417.9	19405.8	1.65	1.36	16.29	16.05				
49	19872.8	19857.5	-2.28	-2.23	15.99	15.97				
50	20345.2	20327.3	-2.31	-2.30	5.40	5.40				
51	20823.8	20810.5	1.00	0.60	3.06	3.01				
52	21319.4	21298.7	-5.52	-5.06	9.59	9.55				
53	21829.1	21802.2	-3.19	-3.88	11.28	11.28				
54	22348.6	22324.2	-5.42	-5.21	14.15	14.22				
55	22883.4	22860.3	0.61	0.65	16.09	15.92				
56	23427.5	23408.4	-0.97	-1.02	16.63	16.73				
57	23991.9	23967.8	-1.38	-1.34	18.41	18.66				
58	24581.5	24555.6	-0.28	-0.36	15.48	15.27				
59	25184.3	25164.4	-1.28	-1.59	19.75	19.43				
60	25793.1	25774.9	-2.06	-1.97	31.31	31.18				
61	26400.5	26386.2	-0.19	0.37	32.20	32.42				
$\bar{X} = 14.32$ meters			$\bar{X} = .023$ knots		$\bar{X} = .059$ knots					
$\sigma = 8.97$			$\sigma = .200$		$\sigma = .195$					
$\sigma^2 = 80.46$			$\sigma^2 = .040$		$\sigma^2 = .038$					

TABLE 16

LAUNCH 2

8 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
4	2140.8	2143.7	-2.76	-2.85	-1.76	-1.78
5	2336.4	2338.2	-3.94	-3.95	-2.37	-2.20
6	2530.4	2533.4	-2.89	-3.02	-1.24	-1.15
7	2729.7	2731.1	-1.93	-1.85	3.36	3.28
8	2937.6	2937.4	-3.58	-3.64	4.35	4.45
9	3144.9	3144.3	-5.37	-5.25	0.15	0.09
10	3338.1	3336.8	-6.86	-6.95	-1.95	-1.84
11	3519.2	3518.4	-7.17	-7.14	-5.68	-5.64
12	3701.4	3700.4	-6.39	-6.45	-9.08	-9.01
13	3892.1	3889.0	-9.52	-9.07	-11.09	-11.22
14	4082.2	4078.3	-9.26	-9.42	-10.27	-10.14
15	4264.4	4262.9	-7.88	-7.90	-8.58	-8.59
16	4450.9	4448.7	-7.31	-7.28	-5.70	-5.70
17	4645.9	4642.4	-4.77	-4.73	-3.80	-3.83
18	4838.2	4835.6	-5.37	-5.38	-4.19	-4.17
19	5021.5	5018.6	-7.63	-7.61	-7.02	-6.98
20	5207.5	5201.9	-7.79	-7.50	-10.95	-10.91
21	5401.3	5394.2	-7.82	-7.94	-12.88	-12.81
22	5598.6	5591.7	-7.93	-7.94	-13.85	-13.83
23	5795.5	5789.2	-6.00	-6.09	-11.77	-11.82
24	6000.4	5993.5	-7.06	-6.87	-10.69	-10.60
25	6217.6	6208.9	-8.91	-8.91	-10.44	-10.40
26	6439.4	6431.2	-7.16	-7.22	-11.06	-11.12
27	6672.3	6666.9	-4.53	-4.48	-6.65	-6.66
28	6918.3	6912.4	-6.76	-6.77	1.74	1.70
29	7164.4	7157.8	-8.28	-8.30	8.56	8.49
30	7400.5	7392.7	-7.77	-7.69	9.67	9.60
31	7627.9	7616.5	-8.52	-8.66	17.23	17.05
32	7851.6	7838.5	-10.10	-9.96	21.47	21.44
33	8079.7	8064.5	-12.43	-12.24	28.18	28.03
34	8325.7	8310.6	-10.29	-10.49	36.77	36.50
35	8583.0	8566.8	-7.38	-7.36	45.59	45.36
36	8841.5	8822.2	-9.32	-9.31	49.98	49.86
37	9105.0	9085.7	-9.49	-9.62	52.98	52.83
38	9373.6	9354.5	-10.61	-10.79	57.13	57.04
39	9639.0	9617.9	-10.71	-10.61	58.01	57.84
40	9900.9	9878.5	-11.95	-11.93	53.84	53.91
41	10185.2	10163.5	-9.66	-9.71	53.12	53.19
42	10481.3	10461.0	-4.90	-5.11	57.02	56.73
43	10775.5	10754.1	-4.86	-4.91	64.53	64.19

LAUNCH 2 (Cont)

8 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
44	11074.3	11050.4	-8.91	-8.94	73.04	72.96
45	11366.6	11343.4	-11.78	-11.71	72.85	72.63
46	11639.3	11616.3	-17.87	-17.76	70.41	70.30
47	11902.3	11879.2	-9.90	-10.14	67.04	67.00
48	12176.3	12154.5	-8.44	-8.28	68.32	68.22
49	12465.1	12442.9	4.27	4.11	56.48	56.82
50	12753.4	12731.6	-1.36	-1.09	63.91	63.82
51	13033.0	13012.2	-14.77	-14.81	56.23	56.09
52	13299.6	13285.2	-8.76	-8.82	53.14	52.84
53	13574.5	13554.5	0.66	0.77	49.45	49.75
54	13875.6	13846.5	6.75	6.44	45.61	45.89
55	14173.7	14142.5	8.65	8.71	38.93	38.62
56	14451.4	14410.6	6.01	5.84	39.45	39.60
57	14709.3	14662.2	10.43	10.40	48.60	48.41
58	14951.6	14912.4	3.78	3.63	50.39	50.13
59	15206.3	15168.2	-0.53	-1.10	43.06	43.00
60	15482.9	15440.5	1.45	1.62	44.41	44.59
61	15767.2	15732.0	1.69	1.74	49.41	49.08
62	16053.3	16020.4	0.32	-0.12	40.90	40.89
63	16325.6	16284.7	6.20	6.38	31.88	32.09
64	16581.1	16549.2	7.34	7.20	27.50	27.25
65	16838.4	16824.2	3.92	3.83	25.04	24.93
66	17107.5	17096.3	6.28	6.10	35.52	35.30
67	17376.1	17360.5	6.90	6.56	40.96	41.11
68	17646.7	17629.1	-7.77	-8.09	36.40	36.25
69	17908.6	17893.5	-8.38	-8.36	25.95	25.82
70	18150.6	18145.6	-5.58	-5.81	19.29	19.10
71	18390.2	18390.2	-8.02	-7.76	19.41	19.52
72	18622.2	18623.7	-0.28	-0.07	16.97	16.96
73	18850.7	18851.4	3.20	3.42	20.80	20.63
74	19085.4	19081.8	3.23	3.12	21.22	21.50
75	19315.3	19311.2	4.33	4.12	18.73	18.73
76	19544.9	19542.3	-2.23	-2.13	22.94	22.98
77	19780.5	19783.4	-5.24	-5.43	15.35	14.83
78	20026.8	20029.2	-7.39	-7.54	11.82	12.12
79	20272.0	20276.0	-0.08	0.21	7.37	7.26
80	20509.9	20518.6	7.50	7.24	12.18	12.11
81	20752.1	20762.9	-10.59	-10.67	9.94	9.75
82	21007.4	21017.8	-4.52	-4.50	7.02	7.26
83	21266.4	21279.6	-0.98	-0.72	12.90	12.79

LAUNCH 2 (Cont)

8 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
84	21525.5	21537.3	-2.90	-2.84	11.98	12.24
85	21775.8	21784.1	0.12	0.06	12.50	12.30
86	22012.9	22022.9	-2.65	-2.99	14.25	13.99
87	22249.6	22263.0	-7.24	-7.23	8.10	8.05
88	22498.3	22507.4	0.98	1.07	6.64	6.89
89	22757.6	22759.9	-0.05	0.02	12.27	12.05
90	23003.4	23014.7	-1.41	-1.64	14.42	14.34
91	23252.6	23266.6	0.99	1.57	12.32	12.32
92	23508.1	23515.6	3.86	2.90	19.46	19.22
93	23756.6	23763.1	-0.47	-0.42	19.68	20.08
	\bar{X}	= 9.87 meters	\bar{X}	= .031 knots	\bar{X}	= .039 knots
	σ	= 14.56	σ	= .180	σ	= .184
	σ^2	= 211.87	σ^2	= .032	σ^2	= .034

TABLE 17

LAUNCH 3

8 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
4	2444.3	2428.8	-1.47	-1.86	2.60	2.88
5	2718.3	2702.1	-0.21	-0.26	5.42	4.95
6	3009.3	2988.3	0.63	0.54	-0.86	-0.23
7	3312.5	3291.2	1.51	1.78	-8.07	-7.96
8	3611.9	3591.5	-1.14	-1.27	-7.86	-7.79
9	3915.5	3893.8	-2.75	-2.61	-8.72	-8.48
10	4225.9	4201.6	-2.35	-2.51	-13.39	-13.33
11	4532.6	4507.1	-5.89	-5.88	-10.17	-10.32
12	4823.2	4798.1	-6.17	-5.93	-8.43	-8.39
13	5116.5	5090.2	-2.87	-2.97	-14.58	-14.18
14	5415.6	5387.4	-6.38	-6.12	-18.85	-18.77
15	5714.9	5685.9	-6.96	-6.81	-21.31	-21.39
16	6015.0	5985.9	-5.47	-5.58	-20.43	-20.37
17	6314.9	6287.0	-1.82	-2.19	-16.75	-16.53
18	6617.1	6590.4	-1.54	-1.39	-16.04	-16.48
19	6921.6	6892.7	-2.43	-2.27	-14.25	-14.41
20	7227.1	7196.4	-6.96	-6.59	-9.88	-9.88
21	7521.6	7490.3	-9.40	-9.57	-6.06	-6.44
22	7812.6	7783.5	-5.57	-5.75	7.32	6.92
23	8108.3	8078.2	-3.18	-3.29	18.10	17.31
24	8416.9	8381.5	-2.50	-2.21	33.79	32.82
25	8718.6	8681.8	-5.52	-5.53	38.19	37.88
26	9008.3	8970.0	-9.79	-10.09	40.26	40.06
27	9303.5	9264.1	-9.11	-8.65	49.07	48.73
28	9580.3	9541.2	-13.26	-13.11	47.99	48.22
29	9844.1	9806.3	-11.90	-12.27	39.06	39.08
30	10128.0	10086.7	-11.85	-12.01	35.71	35.65
31	10435.5	10393.7	-4.07	-4.25	39.23	39.24
32	10739.7	10701.0	1.79	1.63	46.12	45.36
33	11019.3	10981.0	-4.04	-3.79	41.87	42.03
34	11292.4	11254.2	-12.95	-12.55	45.19	44.64
35	11570.8	11532.6	-9.69	-10.22	59.49	58.97
36	11848.3	11809.0	-6.54	-6.63	59.56	59.39
37	12121.6	12084.5	-6.47	-6.45	56.32	56.82
38	12385.3	12352.9	1.63	0.84	48.72	49.15
39	12657.0	12620.4	7.59	7.36	46.08	45.97
40	12939.3	12899.6	6.34	7.06	55.87	55.05
41	13242.2	13204.6	-7.37	-6.98	48.67	49.78
42	13540.8	13504.4	-6.74	-6.97	35.89	35.92
43	13814.3	13778.8	2.74	2.28	34.69	34.73
44	14100.8	14063.0	11.15	10.38	37.12	36.58

LAUNCH 3 (Cont)

8 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
45	14391.3	14350.3	12.26	12.48	48.69	48.41
46	14676.5	14638.4	4.73	5.11	42.97	43.48
47	14966.6	14929.5	4.62	4.14	36.86	36.88
48	15255.2	15218.2	2.48	2.77	38.79	38.82
49	15536.4	15507.3	4.38	4.21	35.15	35.06
50	15825.1	15797.6	3.46	3.71	33.54	33.55
51	16120.9	16089.3	3.16	2.86	31.73	31.97
52	16422.9	16388.9	10.66	10.57	33.42	32.96
53	16734.2	16698.8	10.99	10.83	41.68	41.47
54	17031.9	16996.9	1.05	1.53	39.76	40.24
55	17324.0	17288.6	-6.90	-6.68	27.85	28.39
56	17618.7	17586.4	-1.26	-1.65	20.69	20.27
57	17921.1	17890.2	-0.29	-0.12	30.08	29.87
58	18224.5	18198.4	1.39	0.88	25.51	25.55
59	18528.4	18503.4	1.07	1.03	30.92	30.61
60	18836.5	18808.1	-2.59	-2.03	30.72	30.83
61	19142.2	19118.1	-8.00	-8.37	22.62	22.98
62	19457.6	19436.1	-7.36	-6.95	18.46	18.44
63	19785.8	19759.2	-7.44	-7.38	7.63	8.70
64	20111.4	20083.7	-4.25	-4.73	1.14	0.73
65	20423.0	20399.0	4.39	4.30	12.21	11.71
66	20743.2	20715.1	-0.84	-0.35	20.43	20.71
67	21087.1	21058.4	-3.20	-3.95	3.41	3.67
68	21433.2	21404.9	-1.07	-0.77	9.90	9.66
69	21770.7	21737.8	-5.33	-5.41	12.30	12.09
70	22118.4	22081.7	-2.60	-3.06	10.35	10.88
71	22481.6	22445.8	3.71	3.89	7.65	7.04
72	22855.1	22819.8	1.23	0.98	18.74	18.06
73	23219.9	23183.4	3.85	3.87	23.51	23.40
74	23564.1	23528.5	-4.22	-3.91	22.08	22.51
75	23931.2	23894.4	-3.66	-3.77	22.77	22.31
76	24321.9	24285.8	-6.69	-6.68	21.27	21.14
77	24708.9	24672.0	-3.17	-3.41	21.82	21.68
\bar{X} = 32.02 meters			\bar{X} = .042 knots		\bar{X} = .062 knots	
σ = 3.93			σ = .324		σ = .408	
σ^2 = 15.44			σ^2 = .105		σ^2 = .166	

TABLE 18

LAUNCH 1

9 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
4	2422.1	2425.5	2.77	2.81	1.91	1.88
5	2708.3	2709.0	5.79	5.61	4.59	4.45
6	2998.1	2998.3	9.76	9.58	7.54	8.02
7	3281.6	3283.8	8.44	8.46	1.01	0.83
8	3575.5	3575.9	5.13	5.15	-2.78	-2.83
9	3879.6	3880.8	3.30	3.29	-6.51	-6.25
10	4178.8	4182.4	3.56	3.53	-9.43	-9.49
11	4484.4	4483.4	-0.63	-0.60	-7.61	-7.87
12	4791.0	4788.4	3.09	3.12	-7.77	-7.59
13	5091.6	5090.5	3.01	2.88	-9.34	-9.43
14	5389.8	5386.2	5.67	5.85	-8.20	-8.24
15	5687.4	5682.7	0.36	0.45	-11.70	-11.77
16	5975.8	5972.8	-0.54	-0.50	-11.97	-11.99
17	6270.3	6265.2	-0.58	-0.53	-8.97	-8.97
18	6574.8	6569.8	-3.45	-3.48	-4.03	-3.92
19	6872.9	6868.1	-3.67	-3.54	-3.45	-3.57
20	7185.2	7174.0	-2.37	-2.44	1.87	1.78
21	7514.9	7502.8	-4.16	-4.17	5.83	5.61
22	7841.0	7832.3	-8.28	-8.28	15.39	15.32
23	8159.1	8153.5	-9.51	-9.34	21.86	21.74
24	8474.3	8466.9	-11.70	-11.73	27.65	27.54
25	8781.8	8773.7	-16.79	-16.77	28.75	28.87
26	9087.2	9079.7	-14.08	-14.03	22.99	22.86
27	9403.4	9394.2	-16.47	-16.47	26.85	26.75
28	9713.5	9704.7	-20.40	-20.28	30.38	30.29
29	10005.5	9997.5	-19.00	-19.18	25.60	25.76
30	10312.2	10305.3	-17.69	-17.74	26.33	26.24
31	10636.7	10628.5	-16.38	-16.30	28.69	28.41
32	10960.1	10953.0	-12.18	-12.24	31.72	31.73
33	11297.2	11286.7	-8.74	-8.64	47.64	47.34
34	11615.2	11602.7	-13.20	-13.21	51.62	51.64
35	11914.5	11905.7	-22.88	-22.85	45.55	45.55
36	12245.5	12235.6	-20.42	-20.52	37.02	36.97
37	12591.6	12578.5	-10.00	-9.95	46.19	46.01
38	12923.6	12910.1	-10.48	-10.48	33.98	34.18
39	13254.0	13243.6	-8.20	-8.26	36.13	36.04
40	13578.6	13576.9	-1.33	-1.40	32.57	32.50
41	13915.9	13907.2	1.33	1.54	36.27	35.99
42	14249.0	14242.6	-7.19	-7.28	33.39	33.72
43	14595.1	14585.2	1.21	1.13	32.64	32.38
44	14943.0	14931.3	6.75	6.77	37.84	37.68

LAUNCH 1 (Cont)

9 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
45	15289.3	15278.1	-2.63	-2.71	34.80	34.97
46	15644.6	15632.2	-2.86	-2.74	27.56	27.65
47	16006.1	15993.0	-6.93	-6.95	26.60	26.81
48	16366.9	16353.5	-5.93	-5.77	23.76	23.56
49	16731.4	16716.8	-13.62	-13.74	36.13	36.15
50	17117.1	17096.2	-11.93	-11.69	23.56	22.70
51	17493.2	17470.4	-9.80	-10.02	18.77	19.11
52	17864.7	17843.1	-10.76	-10.75	16.92	16.96
53	18244.2	18225.5	-10.33	-10.23	12.17	12.06
54	18616.9	18601.6	-4.57	-4.60	14.07	13.93
55	18999.6	18980.5	-3.97	-3.95	14.88	14.87
56	19389.8	19374.6	2.71	2.64	14.21	13.99
57	19788.1	19775.1	-3.23	-3.38	11.64	12.04
58	20194.7	20177.3	-3.57	-3.47	8.29	8.26
59	20603.3	20588.6	1.43	1.51	11.17	10.87
60	21007.7	20998.4	0.69	0.72	1.11	1.15
61	21428.4	21414.0	1.79	1.75	7.69	7.94
62	21868.5	21849.6	-0.16	-0.31	12.05	11.96
63	22314.0	22294.5	-7.23	-7.10	1.84	1.69
64	22760.8	22746.5	0.09	0.34	5.04	4.96
65	23219.4	23205.8	2.57	2.37	8.11	8.07
66	23697.5	23682.0	-0.35	-0.52	8.65	8.64
67	24184.6	24169.7	-1.04	-0.74	15.98	15.96
68	24667.5	24648.1	-2.38	-2.39	16.50	16.35
69	25146.4	25127.8	-0.04	-0.14	19.77	19.45
70	25647.9	25626.6	2.32	2.23	33.93	33.54
71	26167.6	26142.0	2.36	2.23	36.41	36.59
72	26690.3	26667.0	-0.36	-0.59	37.24	37.10
73	27221.4	27198.5	0.44	0.46	42.68	42.65
74	27753.2	27730.0	-7.91	-8.13	33.63	33.74
75	28292.4	28270.7	-9.81	-9.58	48.68	48.06
76	28842.1	28816.8	-7.52	-7.91	44.45	44.63
77	29369.6	29342.4	5.90	6.15	49.40	49.42
78	29877.8	29844.5	7.19	7.05	46.44	46.70
79	30415.0	30373.2	6.86	6.89	51.82	50.55
80	30944.1	30909.3	-3.49	-3.51	59.17	58.85
81	31437.5	31409.2	19.40	18.91	52.86	52.82

\bar{X} = 12.51 meters
 σ = 9.03
 σ^2 = 81.59

\bar{X} = .011 knots
 σ = .138
 σ^2 = .019

\bar{X} = .057 knots
 σ = .207
 σ^2 = .043

TABLE 19

LAUNCH 2

9 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
3	2115.8	2117.1	9.26	9.23	-1.35	-1.39
4	2391.5	2389.3	8.13	8.18	-0.76	-0.84
5	2662.6	2656.2	6.15	6.15	1.15	1.01
6	2943.2	2934.8	5.71	5.66	6.11	6.03
7	3222.6	3214.6	8.59	8.41	4.33	4.42
8	3491.1	3484.0	7.75	7.69	-1.20	-1.06
9	3748.1	3738.9	10.26	10.25	-5.46	-5.47
10	3993.6	3981.4	6.60	6.54	-3.75	-3.73
11	4228.2	4219.0	4.66	4.71	-3.55	-3.41
12	4469.3	4458.0	4.37	4.33	-2.74	-3.01
13	4720.2	4706.0	3.10	3.09	-2.54	-2.45
14	4960.1	4944.8	2.66	2.70	-2.46	-2.38
15	5197.6	5178.9	1.95	1.89	-3.82	-3.83
16	5446.4	5426.1	0.55	0.54	-0.13	-0.28
17	5684.2	5662.7	1.27	1.30	1.49	1.56
18	5927.7	5906.8	-1.43	-1.37	9.06	8.91
19	6197.0	6175.2	-4.61	-4.54	16.01	15.87
20	6468.8	6446.1	-4.93	-4.83	18.12	18.00
21	6719.8	6698.6	-6.53	-6.56	20.87	20.77
22	6951.2	6930.3	-9.32	-9.26	20.27	20.13
23	7193.9	7174.2	-12.18	-12.18	21.72	21.76
24	7455.6	7438.3	-9.03	-9.06	26.58	26.45
25	7735.1	7715.5	-11.30	-11.25	29.01	28.87
26	8003.9	7984.1	-7.49	-7.48	30.96	30.95
27	8246.7	8229.7	-7.65	-7.65	31.67	31.52
28	8490.1	8473.2	-8.91	-8.88	34.50	34.55
29	8747.3	8727.6	-10.30	-10.27	36.59	36.30
30	9010.0	8990.0	-10.53	-10.57	40.90	40.98
31	9273.6	9256.3	-6.43	-6.44	43.66	43.48
32	9521.6	9503.6	-9.29	-9.28	47.31	47.26
33	9769.7	9751.4	-23.74	-23.58	48.12	48.10
34	10009.9	9992.2	-31.01	-30.99	50.67	50.55
35	10234.7	10214.7	-35.27	-35.05	47.94	47.86
36	10491.7	10471.4	-33.48	-33.34	45.63	45.80
37	10751.3	10732.2	-29.93	-29.87	45.10	44.87
38	10991.9	10972.4	-28.34	-28.43	42.90	43.01
39	11233.6	11214.7	-20.26	-20.23	38.34	38.20
40	11459.9	11447.4	-9.78	-9.91	39.76	39.70
41	11694.2	11684.0	-5.90	-5.96	36.12	36.43
42	11936.3	11920.5	-6.19	-6.10	28.13	28.08
43	12165.5	12148.1	2.04	1.95	37.66	37.27
44	12396.0	12383.3	-2.56	-2.62	49.88	49.72

LAUNCH 2 (Cont)

9 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
45	12627.0	12618.9	-8.59	-8.57	55.86	55.81
46	12858.6	12850.3	-8.89	-8.79	48.49	48.41
47	13088.6	13079.3	-10.10	-10.32	48.96	48.80
48	13302.7	13297.0	-12.84	-12.95	46.90	46.97
49	13532.8	13530.8	-8.31	-8.36	44.90	45.02
50	13780.8	13774.7	-7.00	-7.37	44.58	44.34
51	14012.9	14003.7	-7.07	-7.07	39.07	39.17
52	14243.7	14236.0	-1.84	-1.62	43.14	42.95
53	14472.1	14466.7	2.44	2.08	44.18	44.18
54	14699.9	14697.3	-2.78	-2.72	47.09	46.74
55	14930.6	14928.8	-7.24	-7.48	45.51	45.63
56	15155.7	15154.2	-9.85	-9.85	37.93	38.24
57	15381.9	15382.9	-13.03	-13.14	28.99	28.86
58	15611.6	15612.0	-16.35	-16.34	30.71	30.71
59	15851.7	15854.3	-11.66	-11.73	27.27	27.04
60	16097.9	16102.7	-7.98	-7.85	23.09	23.19
61	16339.7	16340.6	-6.75	-6.77	23.98	24.11
62	16570.8	16577.6	-7.51	-7.66	28.84	28.82
63	16800.0	16812.6	-9.30	-9.35	27.48	27.38
64	17045.3	17055.2	-7.60	-7.18	21.46	21.24
65	17293.0	17298.0	0.30	-0.02	19.27	19.46
66	17534.7	17534.0	0.86	0.76	20.24	20.09
67	17789.1	17796.9	-5.01	-4.87	13.94	13.91
68	18042.7	18053.3	-3.83	-4.03	13.14	13.18
69	18294.2	18304.9	-0.05	0.37	13.12	13.19
70	18547.8	18556.7	3.79	3.36	17.98	17.87
71	18792.3	18800.1	3.52	3.49	17.19	16.99
72	19033.9	19040.1	-0.51	-0.29	21.06	21.13
73	19278.2	19284.7	-3.92	-4.23	18.23	18.13
74	19533.7	19539.3	-7.69	-7.85	16.60	16.56
75	19791.9	19801.6	-8.34	-8.29	11.93	12.05
76	20047.0	20057.0	-5.35	-5.52	13.24	13.07
77	20316.9	20310.4	-3.23	-3.53	9.08	9.26
78	20582.6	20572.7	-4.71	-4.00	16.29	16.33
79	20833.9	20836.1	-0.10	-0.03	12.24	12.09
80	21086.0	21095.1	5.83	6.12	7.64	7.69
81	21340.8	21349.2	3.56	2.72	15.25	15.21
82	21600.4	21606.9	-5.43	-5.16	9.76	9.62
83	21869.7	21877.1	-8.96	-8.62	7.49	7.53

LAUNCH 2 (Cont)

9 February 1977

H MSL Meters
 NIKE FPS-16
 \bar{X} = 7.10 meters
 σ 11.03
 σ^2 121.64

-N+S Knots
 NIKE FPS-16
 \bar{X} = .011 knots
 σ .200
 σ^2 .040

-E+W Knots
 NIKE FPS-16
 \bar{X} = .042 knots
 σ .140
 σ^2 .019

TABLE 20

LAUNCH 1

10 February 1977

Time	H MSL Meters		-N+S	Knots	-E+W	Knots
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
4	2778.1	2751.2	9.81	10.25	9.49	9.48
5	3064.8	3059.7	9.82	9.67	12.15	12.14
6	3335.3	3332.2	19.47	19.23	11.71	11.90
7	3593.5	3591.0	21.57	21.56	12.89	12.58
8	3826.8	3821.6	24.44	24.43	11.51	11.53
9	4046.4	4040.1	23.45	23.47	9.29	9.29
10	4272.3	4264.1	19.28	19.20	9.16	8.93
11	4490.6	4481.2	19.62	19.86	14.10	14.05
12	4689.4	4681.7	18.25	18.11	14.27	14.24
13	4900.0	4892.9	17.95	18.07	16.47	16.51
14	5140.9	5134.0	22.25	21.97	21.96	21.56
15	5382.3	5374.6	24.16	24.08	28.16	27.98
16	5612.7	5605.3	32.46	32.20	35.27	35.21
17	5833.7	5828.2	35.54	35.54	34.10	34.08
18	6071.7	6064.8	31.83	31.78	43.36	42.86
19	6338.6	6329.7	40.21	40.11	59.82	59.45
20	6586.3	6579.5	43.33	43.23	61.54	61.53
21	6817.7	6811.3	43.90	43.81	63.28	63.01
22	7045.2	7039.8	43.37	43.56	67.08	67.16
23	7270.7	7269.2	40.16	40.14	67.28	67.07
24	7512.9	7510.0	31.94	32.06	67.53	67.44
25	7725.5	7722.5	30.47	30.60	76.63	76.60
26	7889.9	7887.7	30.09	29.91	76.12	76.12
27	8047.7	8047.6	32.39	32.36	76.84	76.67
28	8218.8	8223.1	33.61	33.53	76.32	76.28
29	8407.8	8414.1	34.78	34.62	78.88	78.68
30	8604.1	8607.8	34.55	34.47	78.95	78.95
31	8799.2	8800.7	38.75	38.83	78.01	77.75
32	9000.9	9003.8	40.47	40.47	75.84	75.97
33	9200.7	9214.7	40.33	40.35	75.38	75.60
34	9436.0	9457.7	40.57	40.34	72.92	73.06
35	9717.3	9732.9	37.59	37.54	73.49	73.21
36	9984.0	10003.2	39.31	39.37	73.19	72.99
37	10232.4	10260.3	41.97	42.17	70.13	70.15
38	10476.2	10502.7	46.57	46.69	68.34	68.28
39	10701.8	10730.2	43.35	42.96	73.83	73.39
40	10941.0	10967.2	34.71	35.18	83.43	83.68
41	11202.8	11222.0	23.25	23.17	78.93	79.04
42	11454.6	11476.7	21.32	21.51	71.31	71.56
43	11688.8	11717.7	18.47	18.51	60.30	60.36
44	11904.4	11941.9	24.36	24.08	55.56	55.48

LAUNCH 1 (Cont)

10 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
45	12113.1	12145.2	28.09	28.04	56.33	56.34
46	12319.6	12346.8	18.49	18.88	55.83	55.73
47	12574.3	12606.5	2.19	2.85	50.74	50.90
48	12846.2	12881.4	4.06	3.72	39.97	40.32
49	13103.8	13134.6	2.19	3.06	42.01	41.43
50	13348.7	13380.5	4.03	2.87	41.84	42.40
51	13569.8	13609.6	1.59	2.06	38.64	38.36
52	13800.3	13840.9	-0.55	-0.70	33.27	33.54
53	14036.8	14078.6	-5.34	-5.55	34.76	34.71
54	14261.1	14303.6	-6.99	-6.56	40.63	40.36
55	14484.2	14513.7	-9.63	-9.49	38.52	38.82
56	14710.5	14731.2	-1.91	-1.72	38.91	38.60
57	14938.3	14972.3	1.44	0.92	36.98	36.93
58	15191.8	15228.6	1.03	1.21	35.63	35.58
59	15461.0	15491.8	-1.17	-1.20	35.05	35.37
60	15712.1	15751.0	-0.68	0.08	31.89	31.34
61	15971.2	16015.4	-9.50	-9.73	31.32	31.75
62	16263.4	16296.0	-15.49	-15.57	21.64	21.94
63	16568.6	16597.2	-10.25	-10.54	16.04	15.92
64	16842.2	16882.2	-8.31	-8.49	23.63	23.34
65	17076.8	17122.9	-12.66	-12.80	30.84	31.12
66	17318.8	17363.6	-7.51	-7.75	27.85	27.92
67	17601.6	17615.4	-12.93	-12.36	21.21	21.42
68	17903.4	17906.9	-1.94	-2.28	1.55	1.97
69	18206.9	18234.4	-1.57	-1.48	4.45	4.11
70	18497.2	18531.0	-1.39	-2.27	14.05	13.84
71	18768.2	18797.5	-5.09	-3.89	21.02	20.76
72	19032.4	19054.6	-8.95	-8.94	14.22	14.52
73	19269.3	19301.8	-2.79	-2.92	8.05	7.79
74	19508.0	19560.2	-4.82	-5.16	10.03	9.97
75	19787.0	19833.0	-9.98	-9.89	8.76	9.10
76	20057.4	20104.1	-3.24	-3.15	6.15	6.01
77	20331.3	20386.4	0.30	0.00	0.72	0.82
78	20632.6	20671.0	9.96	10.35	5.38	5.06
79	20919.0	20950.8	3.28	2.58	7.20	7.88
80	21194.7	21230.3	-0.83	-0.72	8.38	8.04
81	21464.9	21509.5	-2.28	-2.05	7.87	7.41
82	21745.8	21791.5	-6.30	-6.30	10.91	11.28
83	22025.2	22067.3	-1.26	-1.94	10.74	10.43
84	22310.1	22350.6	0.51	0.66	9.41	9.58
85	22606.8	22644.6	6.25	5.72	11.76	11.92

LAUNCH 1 (Cont)

10 February 1977

	H MSL Meters		-N+S	Knots	-E+W	Knots
Time	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
86	22893.0	22939.0	-1.92	-1.73	8.28	7.98
87	23174.3	23220.0	-1.27	-1.30	8.40	8.45
88	23456.4	23501.7	-0.17	0.22	10.61	10.52
\bar{X} = 20.58 meters			\bar{X} = .006 knots		\bar{X} = .019 knots	
σ = 20.25			σ = .354		σ = .260	
σ^2 = 410.18			σ^2 = .126		σ^2 = .067	

TABLE 21

LAUNCH 2

10 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
6	2985.7	2989.1	10.60	10.54	12.88	12.86
7	3275.7	3276.4	19.88	19.83	11.73	11.64
8	3561.7	3562.2	19.30	19.25	7.58	7.64
9	3838.6	3839.3	18.22	18.20	5.27	5.21
10	4111.7	4112.1	18.26	18.21	5.48	5.50
11	4393.3	4394.3	25.19	25.07	2.78	2.83
12	4691.8	4691.9	26.41	26.43	8.77	8.58
13	4997.7	4996.9	21.41	21.49	16.01	16.10
14	5276.2	5268.9	26.37	25.85	26.85	25.99
15	5520.6	5509.5	29.25	29.41	27.14	27.51
16	5773.2	5773.4	30.85	30.70	36.50	36.17
17	6064.7	6054.4	33.06	33.08	46.65	46.60
18	6322.8	6314.7	36.97	37.00	51.54	51.63
19	6585.6	6578.8	35.67	35.61	50.98	50.82
20	6856.1	6851.7	30.93	30.98	58.73	58.78
21	7100.5	7096.8	30.38	30.37	69.46	69.45
22	7317.0	7311.6	33.54	33.37	74.62	74.31
23	7538.0	7534.8	35.85	35.93	71.97	71.96
24	7792.8	7794.6	41.82	41.93	70.09	69.95
25	8051.4	8054.6	50.30	50.33	68.69	68.50
26	8280.3	8281.8	49.48	49.39	67.10	67.12
27	8481.9	8486.4	49.28	49.24	69.38	69.18
28	8683.9	8693.7	49.35	49.33	70.95	70.94
29	8906.8	8915.1	48.61	48.56	71.86	72.02
30	9123.3	9131.4	48.19	48.24	70.91	70.70
31	9306.3	9315.6	49.34	49.59	72.84	72.81
32	9481.0	9489.8	50.80	50.60	67.19	67.31
33	9663.8	9672.3	54.73	54.68	64.00	63.88
34	9809.8	9827.8	55.96	55.84	62.86	62.88
35	9927.5	9952.8	59.94	59.95	60.75	60.47
36	10066.8	10090.6	57.02	56.94	67.98	67.87
37	10189.6	10216.9	52.28	53.42	73.01	73.33
38	10268.9	10303.3	50.19	49.95	75.07	74.87
39	10331.5	10374.8	49.68	49.80	75.63	75.53

\bar{X} = - 5.35 meters
 σ = 12.53
 σ^2 = 157.00

\bar{X} = - .001 knots
 σ = .238
 σ^2 = .056

\bar{X} = .068 knots
 σ = .208
 σ^2 = .043

TABLE 22

LAUNCH 3

10 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
3		2348.7		6.07		5.12
4		2719.8		4.00		5.62
5		3104.6		3.95		4.28
6		3461.1		8.13		5.86
7	3789.7	3797.3	7.85	7.87	10.84	10.60
8	4126.3	4131.9	9.98	10.04	12.72	13.07
9	4437.2	4443.7	11.22	11.12	14.97	14.99
10	4744.4	4749.9	13.94	14.15	18.55	18.46
11	5045.9	5048.1	11.70	11.66	19.30	19.25
12	5341.3	5340.5	18.05	17.91	27.32	27.49
13	5601.1	5600.4	16.84	17.03	31.62	31.94
14	5828.4	5828.7	22.38	22.66	33.06	32.93
15	6056.7	6057.9	26.27	26.27	32.58	32.70
16	6308.9	6310.5	24.98	24.89	36.21	36.28
17	6599.2	6601.6	27.81	27.94	45.70	45.93
18	6916.0	6921.2	36.44	36.62	51.10	51.13
19	7245.9	7251.9	38.17	38.27	54.31	54.57
20	7574.9	7581.9	39.18	39.12	62.78	62.73
21	7894.9	7902.9	35.62	35.71	67.03	66.94
22	8202.8	8212.3	42.39	42.53	71.10	71.36
23	8507.5	8517.5	51.12	51.29	76.05	75.99
24	8812.6	8825.2	58.07	58.18	72.62	72.42
25	9120.2	9135.6	55.68	55.54	73.10	73.16
26	9440.9	9455.6	49.86	49.49	70.52	70.45
27	9767.3	9783.5	46.02	46.17	63.77	63.33
28	10105.0	10121.3	45.24	45.02	55.27	54.94
29	10438.1	10453.5	46.45	46.62	53.64	53.72
30	10730.0	10749.1	42.29	41.91	58.34	58.27
31	11002.9	11022.4	35.74	35.36	57.14	56.88
32	11268.3	11292.0	27.54	27.34	48.24	48.26
33	11554.1	11590.6	21.72	21.84	45.59	45.28
34	11897.3	11932.4	13.29	12.27	39.87	39.65
35	12245.7	12273.6	2.19	2.47	31.69	31.63
36	12562.4	12591.9	10.70	10.73	38.22	38.41
37	12859.0	12887.7	11.69	12.09	41.89	42.19
38	13155.3	13187.4	5.11	5.03	40.83	40.10
39	13466.8	13499.6	5.06	4.80	38.42	38.50
40	13779.7	13801.9	1.32	1.40	30.23	30.33
41	14094.3	14118.3	0.19	0.06	35.15	35.17
42	14410.7	14448.8	-1.59	-1.59	34.24	34.15
43	14740.0	14774.2	-3.30	-3.62	39.26	39.51

LAUNCH 3 (Cont)

10 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
44	15074.7	15107.5	-1.83	-1.67	35.18	34.95
45	15408.9	15452.8	-3.71	-3.50	32.51	32.33
46	15753.7	15798.1	-3.97	-4.09	35.40	35.41
47	16096.4	16137.6	-10.84	-10.90	30.00	29.50
48	16436.0	16474.8	-7.00	-6.88	21.05	20.91
49	16770.4	16807.8	-12.13	-12.59	25.88	26.28
50	17110.8	17153.3	-9.21	-8.67	21.55	21.41
51	17468.6	17512.1	0.38	0.26	22.63	22.37
52	17823.1	17867.1	-2.72	-3.31	14.37	14.53
53	18164.0	18213.8	-1.07	-0.71	24.96	25.39
54	18524.1	18558.4	-6.82	-7.24	23.34	22.74
55	18875.6	18912.8	-3.54	-3.09	17.75	17.58
56	19219.6	19266.1	-3.71	-3.60	14.66	14.42
57	19579.1	19618.1	-1.73	-1.54	10.71	10.69

$\bar{X} = -22.52$ meters
 $\sigma = 15.49$
 $\sigma^2 = 240.06$

$\bar{X} = -.003$ knots
 $\sigma = .278$
 $\sigma^2 = .077$

$\bar{X} = .040$ knots
 $\sigma = .258$
 $\sigma^2 = .067$

TABLE 23

LAUNCH 2

11 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
8	3615.1	3613.7	-33.49	-33.36	11.57	11.54
9	3920.5	3919.4	-38.47	-38.40	11.67	11.78
10	4201.5	4201.8	-34.34	-34.24	7.02	6.96
11	4469.5	4469.5	-36.31	-36.28	9.78	9.95
12	4724.5	4722.9	-38.62	-38.70	14.05	13.93
13	4967.7	4966.3	-35.68	-35.50	12.79	12.75
14	5219.1	5219.8	-34.37	-34.62	14.01	14.18
15	5496.1	5500.7	-31.44	-31.26	13.70	13.63
16	5786.2	5790.8	-29.23	-29.16	14.10	14.17
17	6067.9	6073.6	-27.72	-27.71	11.34	11.31
18	6331.5	6340.0	-29.92	-29.91	14.19	14.11
19	6581.8	6592.9	-28.80	-28.87	16.75	16.91
20	6832.2	6841.3	-24.99	-24.66	21.96	21.90
21	7085.3	7090.6	-22.60	-22.78	28.72	28.69
22	7336.5	7337.1	-23.88	-23.73	25.80	25.87
23	7567.0	7568.7	-26.15	-26.23	20.64	20.57
24	7809.4	7819.5	-23.20	-23.21	28.06	28.02
25	8087.7	8097.9	-13.77	-13.72	35.18	35.17
26	8384.4	8396.8	-9.62	-9.83	38.79	38.42
27	8697.3	8712.9	-5.48	-5.18	40.88	40.77
28	9002.8	9015.3	-4.21	-4.45	49.42	49.11
29	9291.5	9301.0	0.53	0.49	50.53	50.61
30	9590.0	9601.5	6.90	7.01	55.36	55.25
31	9907.4	9919.1	8.98	9.33	70.35	70.40
32	10231.3	10237.7	6.53	6.29	73.93	73.70
33	10558.7	10564.5	-0.79	-0.65	76.91	76.85
34	10876.8	10885.0	-2.05	-1.96	68.82	68.82
35	11184.0	11193.4	-3.49	-3.85	57.37	57.43
36	11505.6	11514.2	19.51	19.53	60.18	59.93
37	11834.5	11839.0	21.78	21.98	76.41	76.15
38	12150.9	12151.2	-6.70	-6.44	73.87	74.06
39	12471.4	12470.1	-5.54	-6.15	56.48	56.41
40	12797.6	12797.2	0.99	1.23	50.00	50.36
41	13119.1	13120.2	-1.89	-1.86	49.27	49.08
42	13439.3	13438.7	0.85	0.70	45.55	45.51
43	13750.7	13751.1	5.93	6.11	44.30	44.26
44	14068.3	14070.9	9.71	9.97	45.96	45.99
45	14400.2	14407.6	7.28	7.60	45.50	45.53
46	14736.8	14747.5	-0.79	-0.62	44.63	44.74
47	15080.0	15124.8	2.64	2.59*	36.47	36.28*
48	15442.9	15489.8	-1.79	-5.67*	42.02	40.03*
49	15820.0	15831.5	-11.06	-10.71	34.66	34.85

BAD
DATANOT
USED

LAUNCH 2 (Cont)

11 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
50	16185.2	16207.0	-0.80	-1.13	25.41	25.18
51	16550.9	16575.3	5.31	5.50	19.30	19.51
52	16911.8	16934.2	11.11	10.62	19.24	18.86
53	17257.8	17289.1	11.65	11.72	35.44	35.16
54	17607.5	17639.4	0.88	1.12	32.96	33.05
55	17963.6	17996.0	-0.55	-0.48	27.74	27.75
56	18327.9	18353.6	-2.79	-3.04	23.98	24.14
57	18692.1	18707.5	-7.04	-6.99	17.66	17.72
58	19057.9	19071.5	-10.42	-10.66	16.11	16.11
59	19443.9	19459.2	-1.24	-0.96	7.45	7.40
60	19839.5	19859.6	9.03	8.86	8.93	8.95
61	20246.4	20269.2	5.98	6.64	11.49	11.73
62	20664.7	20682.1	3.74	3.46	10.46	10.55
63	21073.0	21088.3	5.76	5.63	4.19	3.92
64	21478.9	21494.5	5.22	5.37	16.40	16.24
65	21890.1	21907.1	5.61	5.66	9.55	9.62
66	22290.4	22313.2	5.00	4.60	12.03	11.65
67	22688.6	22714.0	-1.99	-2.09	17.80	17.67
68	23113.6	23138.0	-9.25	-9.24	11.60	11.79
69	23552.4	23576.4	-4.41	-4.20	10.59	10.91
70	23993.3	24016.8	2.28	2.03	15.15	14.97
71	24443.7	24463.8	5.16	5.04	14.89	14.77
72	24898.9	24922.2	7.41	7.57	22.23	21.75
73	25355.1	25374.3	1.92	1.22	27.41	27.66
74	25844.9	25855.6	0.95	1.59	34.94	34.70
75	26377.4	26388.1	-3.14	-3.39	35.55	35.69
76	26925.0	26938.5	-2.19	-1.55	25.62	25.64
\bar{X}	=-11.56 meters		\bar{X}	=-.024 knots		\bar{X} = .028 knots
σ	= 9.30		σ	= .265		σ = .175
σ^2	= 86.45		σ^2	= .070		σ^2 = .031

TABLE 24

LAUNCH 3

11 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
2	2077.7	2075.1	-7.52	-7.50	16.30	15.99
3	2422.0	2420.3	-6.13	-6.00	20.60	20.55
4	2671.6	2670.3	-14.99	-14.98	19.22	19.27
5	2926.7	2924.9	-17.41	-17.18	13.10	13.04
6	3216.4	3215.2	-22.73	-22.65	11.60	11.58
7	3527.2	3527.8	-27.81	-27.58	14.07	13.96
8	3863.0	3866.7	-24.44	-24.63	18.03	18.25
9	4197.5	4204.1	-22.32	-22.29	13.86	13.71
10	4530.0	4536.5	-23.22	-23.02	17.99	17.85
11	4842.9	4849.0	-25.63	-25.73	16.70	16.81
12	5123.3	5131.2	-21.78	-21.70	18.85	18.71
13	5377.4	5387.8	-17.20	-17.19	18.87	18.94
14	5621.5	5624.5	-22.89	-23.09	19.68	19.82
15	5866.5	5863.5	-19.29	-19.26	24.03	24.05
16	6114.2	6116.5	-11.30	-11.18	24.90	24.50
17	6383.1	6390.5	-12.13	-11.88	26.05	26.14
18	6681.6	6694.3	-7.32	-7.52	21.76	21.98
19	7003.7	7018.4	-5.61	-5.50	19.24	19.18
20	7341.0	7352.5	-3.97	-4.04	22.03	21.98
21	7687.1	7697.8	-1.60	-1.62	22.44	22.33
22	8029.9	8040.6	-0.70	-0.95	26.88	26.60
23	8366.2	8375.8	1.75	1.85	31.58	31.61
24	8691.7	8696.6	-1.36	-1.50	36.87	36.65
25	8984.6	8980.5	-8.39	-8.31	39.53	39.58
26	9277.4	9270.8	7.28	7.09	45.21	44.93
27	9599.6	9591.7	16.03	15.91	58.19	58.10
28	9922.6	9914.5	17.15	17.27	61.25	61.12
29	10240.0	10232.2	11.67	11.87	67.85	67.77
30	10549.6	10540.9	13.59	13.63	59.56	59.89
31	10850.5	10843.9	30.96	30.53	62.19	61.77
32	11150.3	11144.5	38.60	38.43	78.78	78.35
33	11468.4	11466.9	19.90	20.23	83.75	83.49
34	11804.1	11808.4	3.31	3.47	64.61	65.00
35	12130.7	12138.7	-3.60	-3.48	47.22	47.30
36	12449.0	12459.0	-12.45	-12.54	44.33	44.23
37	12777.0	12784.0	-4.82	-4.81	38.43	38.65
38	13104.5	13114.2	11.79	11.62	44.33	43.92
39	13421.1	13431.4	11.49	11.91	52.69	52.63
40	13737.0	13743.8	3.80	3.73	57.12	57.25
41	14059.5	14073.0	4.34	4.46	54.33	54.12
42	14389.8	14405.5	1.25	0.98	46.58	46.86

LAUNCH 3 (Cont)

11 February 1977

Time	H MSL Meters		-N+S		-E+W	
	NIKE	FPS-16	NIKE	FPS-16	NIKE	FPS-16
43	14720.5	14733.3	4.14	4.14	48.45	48.39
44	15047.7	15063.8	-1.37	-1.09	49.98	49.89
45	15370.1	15391.8	-2.04	-2.50	40.19	40.24
46	15694.0	15720.1	0.01	0.18	24.96	25.06
47	16035.4	16059.1	10.10	9.75	28.72	28.71
48	16391.0	16412.6	18.97	19.22	33.52	33.25
49	16761.9	16781.1	14.93	14.79	35.94	36.16
50	17141.7	17159.5	8.08	8.22	30.44	30.30
51	17517.8	17539.9	7.09	6.85	29.18	29.16
52	17903.3	17930.3	1.21	1.00	25.92	25.70
53	18272.4	18296.9	-0.23	0.00	26.17	26.42
54	18615.4	18643.8	1.78	1.87	16.50	16.39
55	18958.9	18997.7	7.02	6.74	3.65	3.60
56	19295.0	19341.7	2.35	1.83	10.61	10.59
57	19657.8	19698.6	-0.54	-0.17	12.19	12.38
58	20052.8	20084.5	4.85	4.92	18.87	18.75
59	20453.4	20487.5	1.58	1.60	23.31	23.17
60	20864.9	20900.1	6.80	6.70	8.69	8.96
61	21281.4	21318.4	-0.82	-0.50	17.28	16.85
62	21702.6	21732.3	-10.14	-10.70	11.67	12.02
63	22129.1	22154.5	-2.61	-2.11	12.90	13.01
64	22556.0	22580.9	-4.43	-4.25	11.49	11.22
65	22979.4	22996.2	2.72	2.52	5.09	5.53
66	23427.1	23438.4	4.99	4.91	6.69	6.50
67	23880.6	23894.7	4.30	3.78	14.72	14.31
68	24304.2	24323.9	8.51	9.05	23.95	23.84
69	24733.0	24747.7	5.27	5.52	25.56	25.73
70	25176.3	25196.3	-0.84	-0.88	24.80	24.46
71	25636.8	25651.8	-4.39	-4.45	25.17	25.37
72	26093.1	26095.0	-2.40	-2.56	31.64	31.59
73	26528.0	26536.2	4.25	4.36	32.65	32.32
74	26990.8	27006.3	11.67	11.37	40.80	40.48
\bar{X} = - 12.17 meters			\bar{X} = - .002 knots		\bar{X} = .048 knots	
σ = 12.75			σ = .232		σ = .217	
σ^2 = 162.60			σ^2 = .054		σ^2 = .047	

TABLE 25
MEAN, STANDARD DEVIATION AND VARIANCE
OF SPEED AND DIRECTION
7 February 1977

LAUNCH 1

$$\begin{array}{llll} \bar{X}_S = .045 \text{ knots} & \sigma_S = .182 \text{ knots} & \sigma_S^2 = .033 \text{ knots}^2 & \bar{V} = 37.54 \text{ knots} \\ \bar{X}_\theta = -.102 \text{ deg} & \sigma_\theta = .777 \text{ deg} & \sigma_\theta^2 = .604 \text{ deg}^2 & \end{array}$$

LAUNCH 2

$$\begin{array}{llll} \bar{X}_S = .038 \text{ knots} & \sigma_S = .243 \text{ knots} & \sigma_S^2 = .059 \text{ knots}^2 & \bar{V} = 32.45 \text{ knots} \\ \bar{X}_\theta = .002 \text{ deg} & \sigma_\theta = .957 \text{ deg} & \sigma_\theta^2 = .915 \text{ deg}^2 & \end{array}$$

8 February 1977

LAUNCH 1

$$\begin{array}{llll} \bar{X}_S = .077 \text{ knots} & \sigma_S = .159 \text{ knots} & \sigma_S^2 = .025 \text{ knots}^2 & \bar{V} = 30.91 \text{ knots} \\ \bar{X}_\theta = -.119 \text{ deg} & \sigma_\theta = 1.147 \text{ deg} & \sigma_\theta^2 = 1.316 \text{ deg}^2 & \end{array}$$

LAUNCH 2

$$\begin{array}{llll} \bar{X}_S = .050 \text{ knots} & \sigma_S = .167 \text{ knots} & \sigma_S^2 = .028 \text{ knots}^2 & \bar{V} = 27.84 \text{ knots} \\ \bar{X}_\theta = .056 \text{ deg} & \sigma_\theta = .797 \text{ deg} & \sigma_\theta^2 = .635 \text{ deg}^2 & \end{array}$$

LAUNCH 3

$$\begin{array}{llll} \bar{X}_S = .046 \text{ knots} & \sigma_S = .397 \text{ knots} & \sigma_S^2 = .157 \text{ knots}^2 & \bar{V} = 27.25 \text{ knots} \\ \bar{X}_\theta = -.623 \text{ deg} & \sigma_\theta = 3.681 \text{ deg} & \sigma_\theta^2 = 13.549 \text{ deg}^2 & \end{array}$$

9 February 1977

LAUNCH 1

$$\bar{X}_S = .031 \text{ knots} \quad \sigma_S = .212 \text{ knots} \quad \sigma_S^2 = .045 \text{ knots}^2 \quad \bar{V} = 24.98 \text{ knots}$$

$$\bar{X}_\theta = -.121 \text{ deg} \quad \sigma_\theta = .687 \text{ deg} \quad \sigma_\theta^2 = .472 \text{ deg}^2$$

LAUNCH 2

$$\bar{X}_S = .052 \text{ knots} \quad \sigma_S = .144 \text{ knots} \quad \sigma_S^2 = .021 \text{ knots}^2 \quad \bar{V} = 26.92 \text{ knots}$$

$$\bar{X}_\theta = .154 \text{ deg} \quad \sigma_\theta = 1.731 \text{ deg} \quad \sigma_\theta^2 = 2.996 \text{ deg}^2$$

10 February 1977

LAUNCH 1

$$\bar{X}_S = .030 \text{ knots} \quad \sigma_S = .258 \text{ knots} \quad \sigma_S^2 = .066 \text{ knots}^2 \quad \bar{V} = 42.26 \text{ knots}$$

$$\bar{X}_\theta = -.258 \text{ deg} \quad \sigma_\theta = 2.728 \text{ deg} \quad \sigma_\theta^2 = 7.442 \text{ deg}^2$$

LAUNCH 2

$$\bar{X}_S = .081 \text{ knots} \quad \sigma_S = .135 \text{ knots} \quad \sigma_S^2 = .018 \text{ knots}^2 \quad \bar{V} = 63.78 \text{ knots}$$

$$\bar{X}_\theta = .016 \text{ deg} \quad \sigma_\theta = .136 \text{ deg} \quad \sigma_\theta^2 = .019 \text{ deg}^2$$

LAUNCH 3

$$\bar{X}_S = .047 \text{ knots} \quad \sigma_S = .270 \text{ knots} \quad \sigma_S^2 = .073 \text{ knots}^2 \quad \bar{V} = 44.06 \text{ knots}$$

$$\bar{X}_\theta = -.039 \text{ deg} \quad \sigma_\theta = .559 \text{ deg} \quad \sigma_\theta^2 = .312 \text{ deg}^2$$

11 February 1977

LAUNCH 2

$$\bar{X}_S = .063 \text{ knots} \quad \sigma_S = .269 \text{ knots} \quad \sigma_S^2 = .073 \text{ knots}^2 \quad \bar{V} = 35.95 \text{ knots}$$

$$\bar{X}_\theta = -.018 \text{ deg} \quad \sigma_\theta = .928 \text{ deg} \quad \sigma_\theta^2 = .862 \text{ deg}^2$$

LAUNCH 3

$$\bar{X}_s = .059 \text{ knots}$$

$$\sigma_s = .232 \text{ knots}$$

$$\sigma_s^2 = .054 \text{ knots}^2$$

$$\bar{V} = 33.30 \text{ knots}$$

$$\bar{X}_\theta = -.039 \text{ deg}$$

$$\sigma_\theta = .743 \text{ deg}$$

$$\sigma_\theta^2 = .552 \text{ deg}^2$$

TABLE 26
MEAN, STANDARD DEVIATION AND VARIANCE OF
HEIGHT AND COMPONENT WINDS

7 February 1977

LAUNCH 1

$$\bar{X}_H = -7.6 \text{ M}$$

$$\sigma_H = 24.9 \text{ M}$$

$$\sigma_H^2 = 621.33 \text{ M}^2$$

$$\bar{X}_{N-S} = - .017 \text{ Kt}$$

$$\sigma_{N-S} = .263 \text{ Kt}$$

$$\sigma_{N-S}^2 = .069 \text{ Kt}^2$$

$$\bar{X}_{E-W} = .025 \text{ Kt}$$

$$\sigma_{E-W} = .193 \text{ Kt}$$

$$\sigma_{E-W}^2 = .037 \text{ Kt}^2$$

LAUNCH 2

$$\bar{X}_H = -10.75 \text{ M}$$

$$\sigma_H = 18.3 \text{ M}$$

$$\sigma_H^2 = 336.66 \text{ M}^2$$

$$\bar{X}_{N-S} = - .041 \text{ Kt}$$

$$\sigma_{N-S} = .377 \text{ Kt}$$

$$\sigma_{N-S}^2 = .124 \text{ Kt}^2$$

$$\bar{X}_{E-W} = .019 \text{ Kt}$$

$$\sigma_{E-W} = .773 \text{ Kt}$$

$$\sigma_{E-W}^2 = .591 \text{ Kt}^2$$

8 February 1977

LAUNCH 1

$$\bar{X}_H = 14.32 \text{ M}$$

$$\sigma_H = 8.97 \text{ M}$$

$$\sigma_H^2 = 80.46 \text{ M}^2$$

$$\bar{X}_{N-S} = .023 \text{ Kt}$$

$$\sigma_{N-S} = .200 \text{ Kt}$$

$$\sigma_{N-S}^2 = .040 \text{ Kt}^2$$

$$\bar{X}_{E-W} = .059 \text{ Kt}$$

$$\sigma_{E-W} = .195 \text{ Kt}$$

$$\sigma_{E-W}^2 = .038 \text{ Kt}^2$$

LAUNCH 2

$$\bar{X}_H = 9.87 \text{ M}$$

$$\sigma_H = 14.56 \text{ M}$$

$$\sigma_H^2 = 211.87 \text{ M}^2$$

$$\bar{X}_{N-S} = .031 \text{ Kt}$$

$$\sigma_{N-S} = .180 \text{ Kt}$$

$$\sigma_{N-S}^2 = .032 \text{ Kt}^2$$

$$\bar{X}_{E-W} = .039 \text{ Kt}$$

$$\sigma_{E-W} = .184 \text{ Kt}$$

$$\sigma_{E-W}^2 = .034 \text{ Kt}^2$$

February 8 1979 (Cont'd)

LAUNCH 3

$$\bar{X}_H = 32.02 \text{ M}$$

$$\sigma_H = 3.93 \text{ M}$$

$$\sigma_H^2 = 15.44 \text{ M}^2$$

$$\bar{X}_{N-S} = .042 \text{ Kt}$$

$$\sigma_{N-S} = .324 \text{ Kt}$$

$$\sigma_{N-S}^2 = .105 \text{ Kt}^2$$

$$\bar{X}_{E-W} = .062 \text{ Kt}$$

$$\sigma_{E-W} = .408 \text{ Kt}$$

$$\sigma_{E-W}^2 = .166 \text{ Kt}^2$$

9 February 1977

LAUNCH 1

$$\bar{X}_H = 12.51 \text{ M}$$

$$\sigma_H = 9.03 \text{ M}$$

$$\sigma_H^2 = 81.59 \text{ M}^2$$

$$\bar{X}_{N-S} = .011 \text{ Kt}$$

$$\sigma_{N-S} = .138 \text{ Kt}$$

$$\sigma_{N-S}^2 = .019 \text{ Kt}^2$$

$$\bar{X}_{E-W} = .057 \text{ Kt}$$

$$\sigma_{E-W} = .207 \text{ Kt}$$

$$\sigma_{E-W}^2 = .043 \text{ Kt}^2$$

LAUNCH 2

$$\bar{X}_H = 7.10 \text{ M}$$

$$\sigma_H = 11.03 \text{ M}$$

$$\sigma_H^2 = 121.64 \text{ M}^2$$

$$\bar{X}_{N-S} = .011 \text{ Kt}$$

$$\sigma_{N-S} = .200 \text{ Kt}$$

$$\sigma_{N-S}^2 = .040 \text{ Kt}^2$$

$$\bar{X}_{E-W} = .042 \text{ Kt}$$

$$\sigma_{E-W} = .140 \text{ Kt}$$

$$\sigma_{E-W}^2 = .019 \text{ Kt}^2$$

10 February 1977

LAUNCH 1

$$\bar{X}_H = -20.58 \text{ M}$$

$$\sigma_H = 20.25 \text{ M}$$

$$\sigma_H^2 = 410.18 \text{ M}^2$$

$$\bar{X}_{N-S} = .006 \text{ Kt}$$

$$\sigma_{N-S} = .354 \text{ Kt}$$

$$\sigma_{N-S}^2 = .126 \text{ Kt}^2$$

$$\bar{X}_{E-W} = .019 \text{ Kt}$$

$$\sigma_{E-W} = .260 \text{ Kt}$$

$$\sigma_{E-W}^2 = .067 \text{ Kt}^2$$

10 February 1979 (Cont'd)

LAUNCH 2

$$\bar{x}_H = -5.35 \text{ M}$$

$$\sigma_H = 12.53 \text{ M}$$

$$\sigma_H^2 = 157.00 \text{ M}^2$$

$$\bar{x}_{N-S} = - .001 \text{ Kt}$$

$$\sigma_{N-S} = .238 \text{ Kt}$$

$$\sigma_{N-S}^2 = .056 \text{ Kt}^2$$

$$\bar{x}_{E-W} = .068 \text{ Kt}$$

$$\sigma_{E-W} = .208 \text{ Kt}$$

$$\sigma_{E-W}^2 = .043 \text{ Kt}^2$$

LAUNCH 3

$$\bar{x}_H = -22.52 \text{ M}$$

$$\sigma_H = 15.49 \text{ M}$$

$$\sigma_H^2 = 240.06 \text{ M}^2$$

$$\bar{x}_{N-S} = - .003 \text{ Kt}$$

$$\sigma_{N-S} = .278 \text{ Kt}$$

$$\sigma_{N-S}^2 = .077 \text{ Kt}^2$$

$$\bar{x}_{E-W} = .040 \text{ Kt}$$

$$\sigma_{E-W} = .258 \text{ Kt}$$

$$\sigma_{E-W}^2 = .067 \text{ Kt}^2$$

11 February 1977

LAUNCH 1

$$\bar{x}_H = -11.56 \text{ M}$$

$$\sigma_H = 9.30 \text{ M}$$

$$\sigma_H^2 = 86.45 \text{ M}^2$$

$$\bar{x}_{N-S} = - .024 \text{ Kt}$$

$$\sigma_{N-S} = .265 \text{ Kt}$$

$$\sigma_{N-S}^2 = .070 \text{ Kt}^2$$

$$\bar{x}_{E-W} = .028 \text{ Kt}$$

$$\sigma_{E-W} = .175 \text{ Kt}$$

$$\sigma_{E-W}^2 = .031 \text{ Kt}^2$$

LAUNCH 2

$$\bar{x}_H = -12.17 \text{ M}$$

$$\sigma_H = 12.75 \text{ M}$$

$$\sigma_H^2 = 162.60 \text{ M}^2$$

$$\bar{x}_{N-S} = - .002 \text{ Kt}$$

$$\sigma_{N-S} = .232 \text{ Kt}$$

$$\sigma_{N-S}^2 = .054 \text{ Kt}^2$$

$$\bar{x}_{E-W} = .048 \text{ Kt}$$

$$\sigma_{E-W} = .217 \text{ Kt}$$

$$\sigma_{E-W}^2 = .047 \text{ Kt}^2$$

TABLE 27

MEANS, STANDARD DEVIATIONS AND VARIANCES
OF ALL RUNS TAKEN TOGETHER

$\bar{X}_S = .049$ knots	$\sigma_S = .236$ knots	$\sigma_S^2 = .056$ knots ²	$\bar{V} = 33.94$ knots
$\bar{X}_\theta = -.096$ deg	$\sigma_\theta = 1.657$ deg	$\sigma_\theta^2 = 2.747$ deg ²	
$\bar{X}_H = 3.491$ meters	$\sigma_H = 21.327$ meters	$\sigma_H^2 = 454.860$ meters ²	
$\bar{X}_{N-S} = .004$ knots	$\sigma_{N-S} = .265$ knots	$\sigma_{N-S}^2 = .070$ knots ²	
$\bar{X}_{E-W} = .040$ knots	$\sigma_{E-W} = .323$ knots	$\sigma_{E-W}^2 = .104$ knots ²	

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